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MANUAL

OF

SEAMANSHIP.

Vol. I.

1908.

(Revised and Reprinted 1915.)

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PREFACE

THE Seamanship Manual is divided into two parts. Volume I. comprises such information in the elements of Modern Seamanship as is necessary for the instruction of Naval Cadets, Boys and Youths in the Harbour Training Establishments, and Volumes I. and II., taken in conjunction, are intended to serve as a convenient text-book for the use of Sub-Lieutenants, Midshipmen, and Petty Officers and men desirous of qualifying for higher ratings.

The Lords Commissioners of the Admiralty wish to acknowledge the courtesy of Captain Austin M. Knight, United States Navy, in allowing the unreserved use of his "Modern Seamanship," published by J. D. Potter, 145, Minories, London, in the revision of the Seamanship Manual; also of Commander Wilfrid Henderson, Royal Navy, for the use of his "Seamanship," published by Griffin and Co., of Portsmouth; and of James Brown and Son, of Glasgow, for the use of the "Knot Book and Ships' Lights."

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CONTENTS.

CHAPTER I.

PAGE

Bag and Hammock—Salutes on Board and on Shore—Marks of Rank—Navy and Army Distinguishing Badges—Time—Seamen Watches—Tricks - - - - - - - - 1

CHAPTER II.

SIGNALS.

Union Jack—Ensigns—Royal Standard and Personal Flags—Hoisting and Hauling down Ensign—National Flags—Naval Code of Signal Flags—Substitutes—Semaphore—Flag-waving—Flashing—Morse Code—Flashing Lamps—Searchlight Signalling—Boats' Signals—Recalls—Distinguishing Flags worn in Boats—Salutes in Boats—Replies at Night—International Code—British Signal Manual—International Salutes—Ensigns - 26

CHAPTER III.

Bends — Hitches — Knots—Splices—Seizings—Rope-making —Mat-making—Sail-making—Blocks—Purchases - - - 59

CHAPTER IV.

Lead and Line—Sounding Machines—Patent Logs—Forbes' Ship's Log—Speed Indicators - - - - - - 130

CHAPTER V.

Mariner's Compass—Binnacle—Kelvin's Compass—Liquid Compass — Binnacle — Gyro Compass — Standard Compass — Boat's Compass—Compass Card—Hints on Learning the Compass—Remarks on Steering - - - - - - - 170

CHAPTER VI.

BOAT WORK.

Parts of a Boat—Different Builds—Gear contained in—Boat-pulling—Lowering and Hoisting—Robinson's Disengaging Gear —Pett's Disengaging Gear—Life-belts—Davits—Management of Pulling Boats—Towing—Hauling up on Beach—Landing in a Surf—Rowing to Seaward—Running before a Broken Sea—Boarding a Wreck—Watering Ship—Parts of Sails—Different Rigs—General Working under Sail—Steamboats—Gear contained in—Management of—Raising Sunken Boat—Table of Weights, Areas, &c.—General Racing Rules - - - - 201

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CHAPTER VII.

Rule of the Road.

PAGE

Aids to Memory—Special Lights carried by H.M. Ships—Marking Wrecks—Sound Signals for Fog—General Rules—Lights carried by Vessels - - - - - - - - 268

CHAPTER VIII.

Anchor Work.

Different Pattern Anchors—Cables—Stoppers—Slips—Compressor—Controller—Capstans and Cable Holders (Harfield, Napier, Electric)—Stowage of Anchors—Cable Leads—Anchoring—Weighing—Mooring and Unmooring—Clearing Hawse—Securing to a Buoy—Securing between two Buoys—Laying out Anchors—Surveying Cables—Laying out Hawsers - - - 272

CHAPTER IX.

Rigging.

Sailing Ships and Vessels—Modern Masts—Rigging of Lower Masts—Topmast and Rigging of—To Strike a Topmast—Topgallant Mast—Running Rigging—Signal Yards—Steel Wire Rope—Boat-hoisting Derricks—Rigging of Derricks—Derrick Blocks—Fore Derrick—Tests for Derricks—Boat-hoisting Machinery (Steam, Electric, and Hydraulic)—Hoisting in a Steamboat—Working Main Derrick by Hand—Sheers and Derricks—Collision Mats—Torpedo Net Defence—Coaling—Awnings—Awning Curtains—Side Screens - - - - - - - - 323

CHAPTER X.

Miscellaneous.

Watertight Doors and Valves—Man Overboard—Lifebuoys—Life Saving—Restoring apparently Dead—Hints to Bathers—Meteorological Instruments—Winds—Force of—Measurements—Provisions—Weights—Measures—Sea Terms—Syllabus of Courses - - - - - - - - - - - - 348

Index - - - - - - - - - - - - 433

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CHAPTER I.

BAG AND HAMMOCK INSTRUCTION.

To sling a Hammock.

A hammock is slung by clews, which are made of 3-strand white hemp, $\frac{5}{8}$ of an inch in circumference; the nettles are secured to a metal ring through which the lanyard is spliced. In slinging a hammock care must be taken to give the centre nettles more scope than the side ones.

To hang a Hammock up, and secure the Lanyards properly.

The end of the lanyard is placed over the hammock hook, then through the ring, again over the hook, through the ring, triced up to the height required, and the end secured by two half hitches.

To lash a Hammock up.

Distribute the bedding equally over the whole length of the hammock, to prevent it appearing, when lashed up, more bulky in one part than another. Then pass the lashing, seven turns being taken, the first being a running eye and the remainder marline hitched.

Care should be taken that the turns are equi-distant, also that the first and last turns are clear of the bedding.

Lay the hammock on the deck, name down, and then twist the clews and tuck them under the lashing towards the centre.

To lash a Hammock up for Night Quarters, or in case of Fire.

The number of turns taken is three only, and the hammock is triced up to the beams, or is stowed in the nettings as ordered.

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To stop a Hammock or piece of Clothing on a Gantline or Clothes-line.

Hammocks are fitted with five stops, three in the head 18 inches long and two in the foot 9 inches long: the centre head stop is secured with a clove hitch to the gantline, the head of the hammock is then hauled taut along the gantline, the outer stops being secured with a rolling hitch; the foot stops are reef knotted to the foot stop of the hammock on either side of them. Hammocks are always "stopped on" with names up and inboard.

Hammocks are always to be "locked in" (the outer stops of a hammock should be well inside the outer stops of the hammocks on either side), no intervals being left.

Hammocks are marked with the owner's name in black painted 1-inch block letters, the centre letter of the name being on the centre seam, and the lower edge of the letters being 21 inches from the head of the hammock.

Blankets are fitted with similar stops to those in hammocks, and are hung up in the same way.

On leaving the training ship every boy is given two hammocks and one complete set of clews, lanyards, and lashings, which he marks with his name as above, and retains until worn out, or until he leaves the Service.

To hold up a clean Hammock for Inspection.

It is held by the two corners of one end in front of the body in line with the chin, name uppermost, and towards the inspecting officer.

To mark Bedding.

A 1-inch block letter type is to be used.

Beds are marked on the foot, name facing the foot.

Blankets at the head, name facing the foot.

Bed-covers on the outside at the sewn-up end, facing the open end.

To scrub a Hammock.

After scrubbing with soap it should be re-scrubbed with salt water so as to take the soap out of it, the space round the name is cleaned by rubbing with the hand, instead of scrubbing it with the deck scrubber.

Stops should be put in before scrubbing the hammock.

Stowage of Clothing.

A waterproof canvas bag will be issued to every boy on his leaving the training ship, with his name stamped

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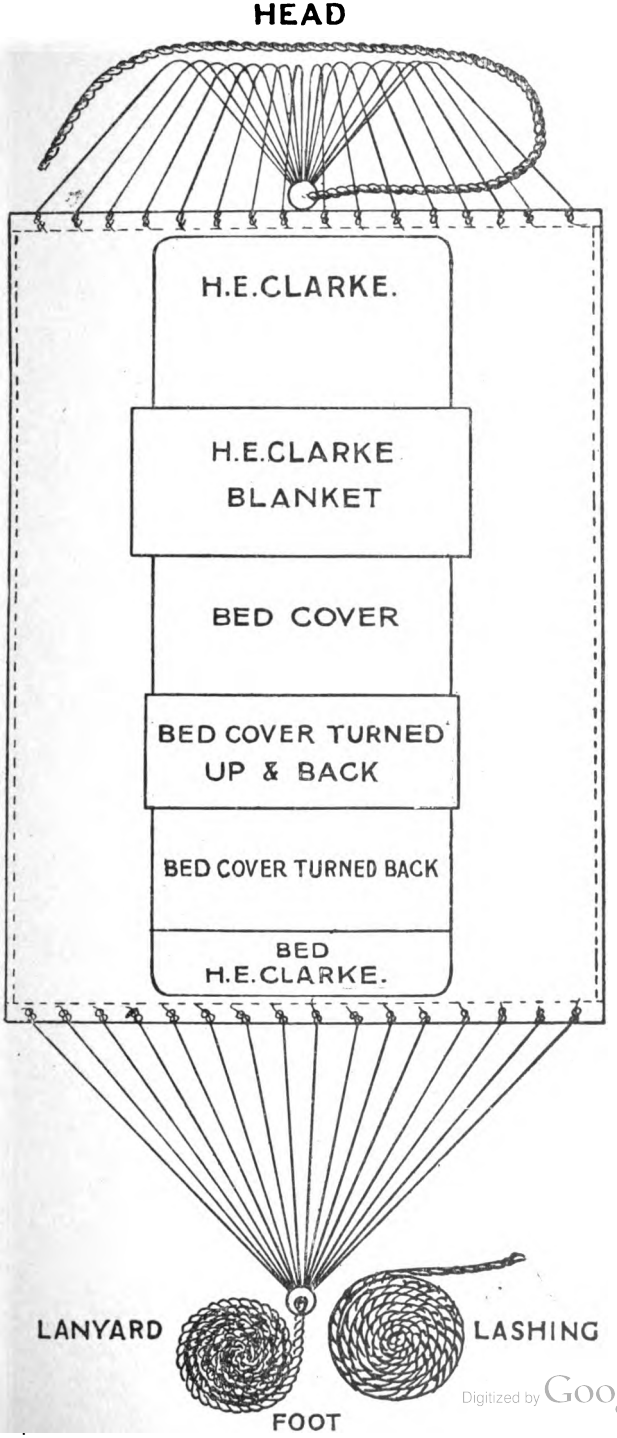
BEDDING. [*To face page* 2.

To be laid out for Inspection as shown herein.



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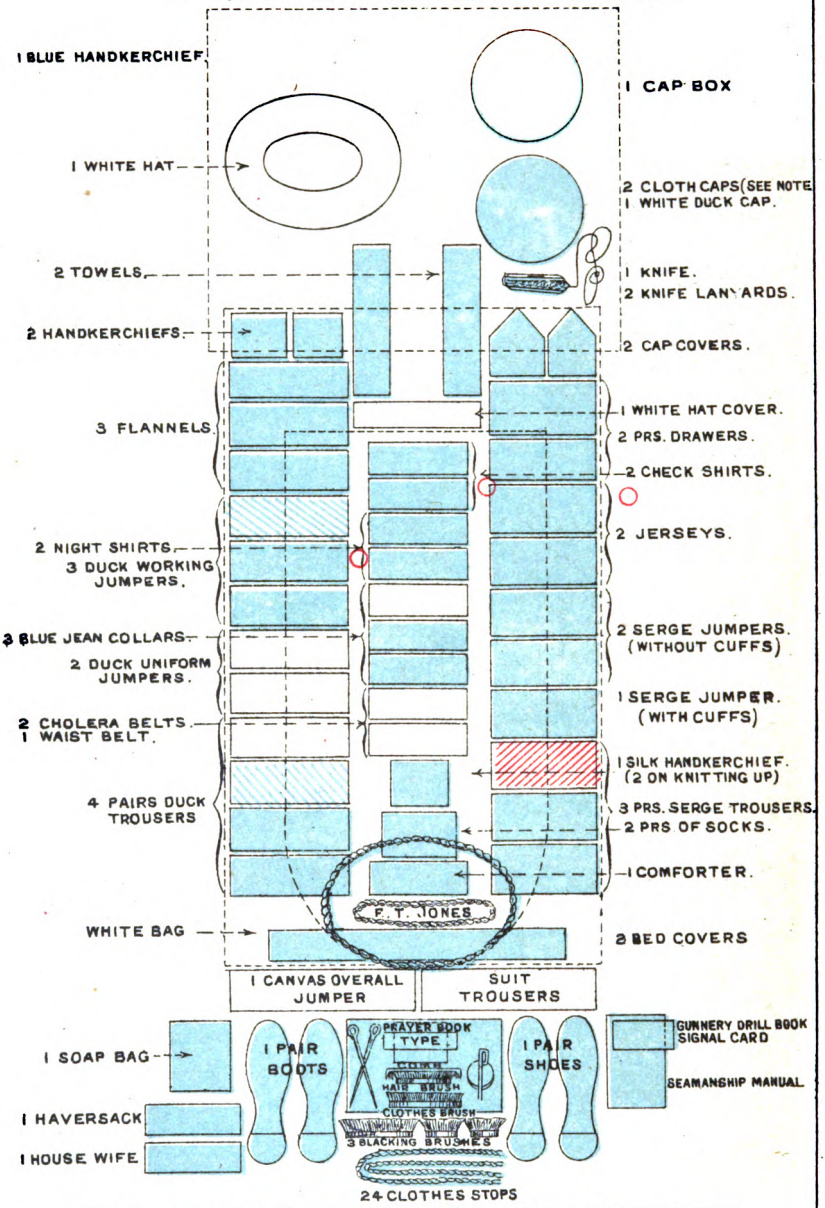
1ST AND 2ND CLASS BOY'S KIT.



NOTE, BOYS 2ND CLASS WEAR A SERGE CAP IN PLACE OF 1 OF THE CLOTH CAPS
THE OUTER CLOTHES STOPS TO BE IN LINE WITH THE EDGE OF BAG.

ON KNITTING UP FOR SEA.

ON BEING RATED BOY 1ST CLASS.

ON COMPLETING SEAMANSHIP COURSE.

OPTIONAL AT SEA.

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on a brass tally secured to the bottom of the bag. He will retain the bag until it is worn out or until he leaves the Service.

To stow the Kit in a Bag.

The clothing is either folded up flat or rolled and tied up in handkerchiefs, care being taken that the white and blue clothing is placed in separate bundles ; clothing not often worn being at the bottom.

How to put in a Clothes Stop.

Reeve it through the eyelet holes, then centre it, and tuck one end through a strand of the other.

Washing Clothes.

When doing this care should be taken to thoroughly rinse them out ; in the case of duck clothing, salt water might be used. It is not advisable to wash flannels in hot water or to rinse them in salt water. In all cases clothes stops should be put in before wetting the clothes. Clothes are stopped on the clothes lines by passing the stops round the line and then reef knotting, care being taken that each piece is locked inside the piece on either side.

How Clothing is Marked.

The clothes of men dressed as seamen are marked with a $\frac{3}{8}$-inch type, block letters, as follows :—

Blue clothes with white paint.
White clothes with black paint.
Jerseys, socks and comforters with red worsted.
Jackets, in upper part of sleeve.
Trousers, on the inside of the waistband at back.
Frocks and jumpers (excepting working jumpers), under the collar.
Working jumpers, on the back close up to the collar.
Flannels, check shirts, on the tail.
Caps in the crown.
Cap-covers, inside the band.
Handkerchiefs, diagonally across the four corners.
Boots and shoes are stamped inside the upper.
Jerseys, on the inside of the bottom tabling.

To mark Clothing.

See that the type is clean, and the paint not too thick. White paint is used for marking dark clothing and black for white clothing. Clothes should never be marked when rolled up.

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Naval Salutes and Marks of Respect.

(1) The Naval Salute is made by bringing up the right-hand to the cap or hat, naturally and smartly, but not hurriedly, with the thumb and fingers straight and close together, elbow in line with the shoulder, hand and forearm in line, the thumb being in line with the outer edge of the right elbow, with the palm of the hand turned to the left, the opposite being the case when using the left hand.

(2) When passing an officer, the salute is to be made with the hand furthest from him, and commenced just before meeting, and continued until well past the officer, the person saluting looking towards him at the same time.

(3) A petty officer or seaman riding a bicycle is to salute by turning his head smartly towards an officer when passing him.

(4) Every officer should return a salute made to him, a salute made to two or more officers being returned by all the officers.

(5) The term "officer" includes all Commissioned, Warrant, and Subordinate Officers.

(6) The junior officer, of whatever rank, should on all occasions salute his senior when passing, addressing, or being addressed by him, by making the salute, which the senior officer should return.

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(7) When coming over the gangway or on to the quarter deck the salute is to be made.

(8) Petty officers and men are to salute all officers—

(*a*) When addressing, or being addressed by an officer, and again on withdrawing.

(*b*) When passing or being passed by an officer.

(*c*) Officers passing a ship in a boat are to be saluted by those men on board who may be in sight of the boat.

(9) All officers in uniform, both Naval and Military, and also those in plain clothes who are known to be officers, are to be saluted. It is to be understood that there is no excuse for not seeing an officer, or for not recognising an officer in plain clothes, who, either from his position or by belonging to the same ship as the man, ought to be known by him.

(10) Should a Petty Officer or man be standing about, and an officer pass him, he is to face the officer and salute; if sitting when an officer approaches, he is to rise, stand at attention, and salute. If two or more Petty Officers or men are sitting or standing about, the Senior Petty Officer or man will call the whole to attention and he alone will salute.

(11) When men are marching, or fallen in in charge of an officer or Petty Officer, the officer or Petty Officer is to salute, giving the usual command.

(12) Officers and men passing a funeral will salute the body.

(13) When inspected by a Flag Officer, or Captain, or by the officer in command of the ship, of whatever rank, all Petty Officers and men are to take off their hats or caps on the order being given by the officer in charge.

(14) When being mustered by a Flag Officer, or Captain, or by the officer in command of the ship, of whatever rank, all Petty Officers and men are to take off their hats or caps as they pass round.

(15) When a Petty Officer or man is brought before an officer as a defaulter, or for the purposes of any investigation, he is to take off his hat or cap.

(16) When inspected by an officer at Divisions, Quarters, Watch fall in, and on all other occasions of falling in for inspections without arms, the men are to be called to attention, the Petty Officers saluting as the officer passes them.

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MARKS OF RANK—OFFICERS.

Officers wear distinguishing gold lace, and, in the case of the Civil Branches, coloured cloth, on both sleeves of their coats. When wearing a great-coat and in white uniform, the lace and cloth are worn on shoulder-straps.

Officers are divided into two branches, executive and civil. The Civil Branch is sub-divided into Engineer, Medical, Accountant, and Naval Instructor Officers.

Branches are distinguished as follows:—

Executive (Military)	By a circle on the upper row of lace.	
Engineer	Do. do., and purple cloth between the lace.	
Medical	By scarlet cloth.	In conjunction with the gold lace stripes, between them or below them, not above them.
Accountant	By white cloth.	
Naval Instructor	By light blue cloth.	
Assistant Constructors	By silver-grey cloth.	

The lace worn on the sleeves and shoulder-straps differs in breadth according to the rank of the officer, as follows:—

(*The Measurements shown are Inches.*)

Admiral of the Fleet	1 row of $1\frac{3}{4}$ and 4 rows of $\frac{5}{8}$.
Admiral	1 row of $1\frac{3}{4}$ and 3 rows of $\frac{5}{8}$.
Vice-Admiral	1 row of $1\frac{3}{4}$ and 2 rows of $\frac{5}{8}$.
Rear-Admiral and Commodore, 1st class	1 row of $1\frac{3}{4}$ and 1 row of $\frac{5}{8}$.
Commodore, 2nd class	1 row of $1\frac{3}{4}$.
Captains	4 rows of $\frac{1}{2}$.
Commanders	3 rows of $\frac{1}{2}$.
Lieutenant Commander	2 rows of $\frac{1}{2}$, with a row of $\frac{1}{4}$ between them.
Lieutenant	2 rows of $\frac{1}{2}$.
Sub-Lieutenant, Chief Gunners and Chief Boatswains	1 row of $\frac{1}{2}$.
Gunners and Boatswains over 10 years' seniority	1 row of $\frac{1}{4}$.

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In the case of Flag Officers and Commodores, 1st class, the upper row of lace forms a circle, above the row, 2 inches in diameter. In the case of a Commodore, 2nd class, a circle of ½-inch lace is placed just over the 1¾-inch band. All other Executive and Engineer Officers have a band of lace the width of the upper row, formed into a circle above the upper row, the circle being 1¾ inches in diameter.

Officers of the Civil Branches have the same number of rows of lace as officers of corresponding rank in the Executive Branch, the upper row being straight and having no circle above it. The spaces between the lace are filled with the coloured cloth previously referred to. The width of the coloured cloth is ¼ inch.

Warrant Mechanicians wear the same purple cloth as the Engineering Branch and Head Wardmasters the scarlet cloth similar to Medical Officers.

Warrant Officers under 10 years' seniority do not wear distinguishing lace, but have three buttons on the sleeves, and, in the case of Engineer Warrant Officers, a band of purple cloth ¼ inch wide under the buttons.

Subordinate officers do not wear distinguishing lace, but *Midshipmen* wear, on each side of the collars of their coats a white turnback of 2 inches, with a notched hole of white twist 1¾ inches long, with a corresponding button; *Naval Cadets* wear on each side of the collars of their coats a button hole of white twist 1¾ inches long, with a corresponding button. *Clerks and Assistant Clerks* wear round each cuff of the coat a row of white cloth ¼ inch wide.

Flag Officers and Commodores, 1st class, and officers of the Civil Branch ranking with them, wear devices on their shoulder-straps, but all other Commissioned Officers and Warrant Officers over 10 years' seniority, wear the same distinguishing lace on the shoulder-strap as on the cuff.

Subordinate officers do not wear shoulder-straps.

Warrant Officers under 10 years' seniority wear plain shoulder-straps.

Officers (executive or civil) serving on the staff of a Flag Officer or Commodore, and Naval Attachés wear aiguillettes (*i.e.*, ropes of gold lace hung from the shoulder) on the *left* shoulder.

Aide-de-Camps to the King, Admirals of the Fleet, and Honorary Physicians and Surgeons to the King wear aiguillettes on the *right* shoulder.

If a Naval Attaché is also an Aide-de-Camp to the King he wears the Aide-de-Camp's aiguillettes on the right shoulder only.

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DISTINCTION LACE WORN BY NAVAL OFFICERS.

——	Military Branch.	Without the Curl, but with		
		Purple between Stripes.	Scarlet between Stripes.	White between Stripes.
	Admiral of the Fleet.	——	——	——
	Admiral.	——	——	——
	Vice-Admiral.	Engineer-in-Chief if Engineer Vice-Admiral.	Medical Director-General.	——
	Rear-Admiral and Commodore 1st Class.	Engineer-in-Chief if Engineer Rear-Admiral.	Surgeon-General.	——
	Commodore 2nd Class.	——	——	

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DISTINCTION LACE WORN BY NAVAL OFFICERS.

—	Military Branch.	With the Curl and Purple between Stripes.	Without the Curl, but with	
			Scarlet between Stripes.	White between Stripes.
	Captain.	Engineer-Captain.	Deputy Surgeon-General.	Paymaster - in - Chief also Secretary to a Flag Officer (if with over 5 years' service as Secretary to a C.-in-C.).
	Commander.	Engineer-Commander.	Fleet-Surgeon.	Fleet Paymaster also Secretary to a C.-in-C.
	Lieutenant-Commander.	Engineer-Lieutenant (over 8 years).	Staff Surgeon.	Staff Paymaster or Paymaster also Secretary to a Flag Officer other than a C.-in-C. or to a Commodore 1st class or Captain of the Fleet.
	Lieutenant.	Engineer-Lieutenant (under 8 years).	Surgeon.	Assist. Paymaster (over 4 years) also Secretary to a Commodore 2nd class.
	Sub-Lieutenant and Mate.	Engineer-Sub-Lieutenant and Mate(E.)	—	Assist. Paymaster (under 4 years).

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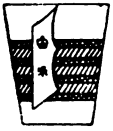
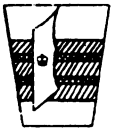
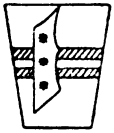
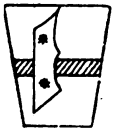
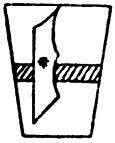
DISTINCTION LACE WORN BY MILITARY OFFICERS.

Stripes.	
	Colonel.
	Lieutenant-Colonel.
	Major.
	Captain.
	Lieutenant.
	2nd Lieutenant.

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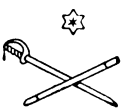
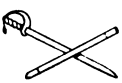
RELATIVE RANKS, &c.

SHOULDER BADGES.

(FULL DRESS.)

Navy.		Army.	
Admiral of the Fleet.			Field-Marshal.
Full Admiral.			General.
Vice-Admiral.			Lieutenant-General.
Rear-Admiral and Commodore 1st class.			Major-General.
(Commodore 1st Class ranks with a Brigadier-General.)			
Commodore 2nd class.			Brigadier-General.

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Navy.		Army.	
Captain over 3 years.			Colonel.
Captain under 3 years.			Lieutenant-Colonel.
Commander.			Lieutenant-Colonel.
Lieutenant over 8 years.			Major.
		(But a Major of Marines ranks with a Commander when afloat.)	
Lieutenant.			Captain.
Sub-Lieutenant.			Lieutenant.

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DISTINGUISHING BADGES—MEN AND BOYS.

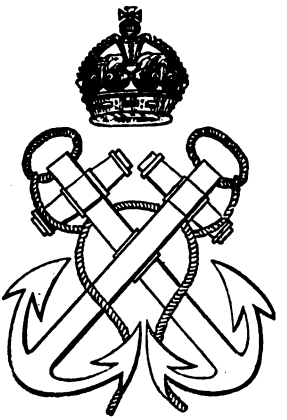
Men, of all ratings, whether dressed as seamen or not, if they are below the rating of Chief Petty Officer, wear their distinguishing badges for substantive ratings on the left arm and for non-substantive ratings on the right arm. Thus, if a man is a petty officer and a gunner's mate he wears the distinctive badge of a petty officer (two anchors crossed, surmounted by a crown) on his left arm, and the badge for a gunner's mate on his right arm. In the case of the Civil Branches (stoker, carpenter, armourer, &c.) the badge showing the relative rating with the Executive Branch (*i.e.*, petty officer or leading seaman) is worn on the left arm, and the badge indicative of their duties on the right arm.

Good shooting badges are worn on the right arm, *below* the non-substantive rating badges, 1½ inches above the right cuff.

In the case of Seamen Chief Petty Officers, the distinguishing badge of their non-substantive rating, in the case of those with a gunnery or torpedo rating, and a single anchor in the case of those without, is worn on both sides of the front of the collar of their coats. Men belonging to the Civil Branches with the rating of Chief Petty Officer wear the badge indicative of their duties on both sides of the front of their collars, with the exception of engine-room artificers, who wear no badge at all. In addition, Chief Petty Officers, and men ranking as such, wear distinctive gilt buttons on their coats, and they do *not* wear good conduct badges.

(A) Badges of rating worn on the left arm :—

(1) Petty Officer and a man ranking as such.



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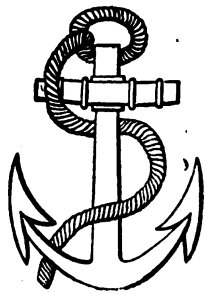
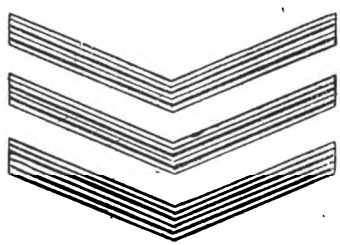
(2) Leading Seaman, Leading Signalman, and men ranking as such.



NOTE.—These badges (Nos. 1 and 2) are worn *above* the good conduct badges.

Good Conduct Badges.



(B) Distinguishing badges worn on right arm, and, in the case of Chief Petty Officers, and men ranking as such, on the front of the collars of their coats :—

NOTE.—A star *above* a badge in every case indicates a man of superior qualifications, and another star *below* denotes that a man had passed for and is performing certain special duties.

(1) Chief Petty Officers, Seaman Class, without gunnery or torpedo rating.

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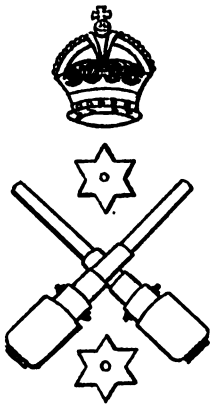
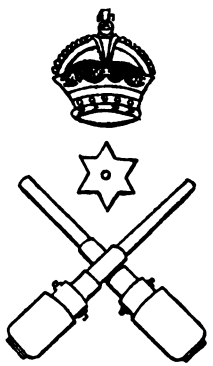
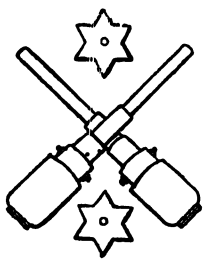
(2) Gunner's Mate and Gunlayer 1st class (Man holding both ratings).



(3) Gunner's Mate.



(4) Gunlayer 1st class.



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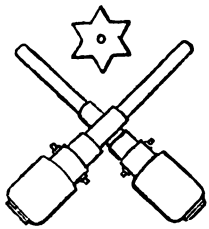
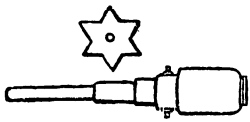
(5) Gunlayer 2nd class.



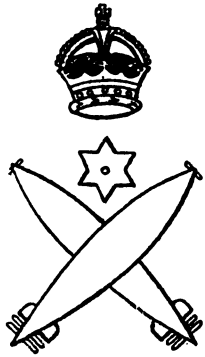
(6) Gunlayer 3rd class.

Same badge as Gunlayer 2nd class, omitting the star.

(7) Chief Petty Officer (G.) and Petty Officer (G.) (not being Gunlayer or Gunner's Mate) and Seaman Gunner.



(8) Torpedo Gunner's Mate.



(9) Torpedo Gunner's Mate (Higher Standard).

Same badge as No. 8, with a star *below* the crossed Torpedoes, as well as above.

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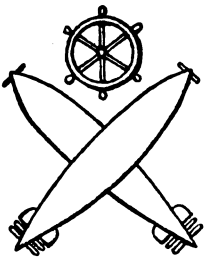
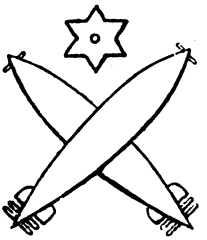
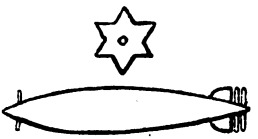
(10) Torpedo Coxswain.



(11) Leading Torpedo Man.



(12) Chief Petty Officer (T.) and Petty Officer (T.) and Seaman Torpedo Man.



(13) Chief Yeoman of Signals.

Same badge as No. 14 (Yeoman of Signals), with a Crown above the upper star. The badge thus consists of crossed flags with a star and crown above, and two stars below.

(14) Yeoman of Signals.

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(15) Leading Signalman.

(16) Signalman.

(17) Ordinary Signalman and Boy.

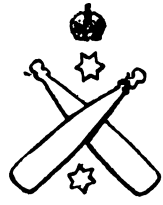
(18) Wireless Telegraphy Branch.

The distinguishing badge as worn by Boys and Ordinary Telegraphists is as follows :—

A Telegraphist's badge has a small star above the device; a Leading Telegraphist's has a star above, and also one below the device.

Chief Petty Officer and Petty Officer Telegraphists wear a small crown above the device, and no stars.

(19) Physical Training Instructor 1st Class.



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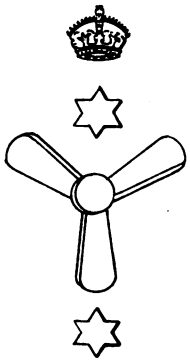
(20) Physical Training Instructor 2nd class.

Same badge as No. 19 without the star below the crossed clubs.

NOTE.—A Physical Training Instructor is not allowed to wear any other distinguishing badge than the badge of that rating, except a good shooting badge.

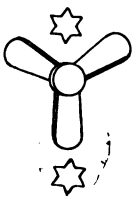
Engineer Branch.

(21) Mechanician.



(22) Chief Stoker.

(23 Stoker Petty Officer.



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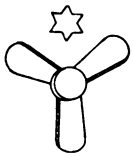
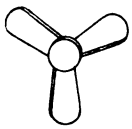
(24) Leading Stoker passed for Stoker Petty Officer.

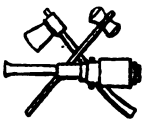


(25) Stoker.



(26) Chief or other Armourer.

(27) Armourer's Mate or Crew.



(28) Blacksmith, Plumber, Painter 1st class, and all Chief and other Carpenter's Mate, or Skilled Shipwright of whatever rating.

(29) All other Artizans.

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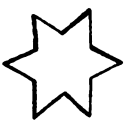
(30) Naval Police.

(31) Schoolmaster,
Ship's Steward,
Ship's Steward's Assistant,
Ship's Steward's Boy,
All writers.

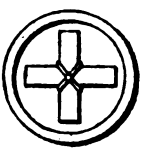
Above have the star, gold on cloth.

All Cook ratings.

Star, silver on cloth.

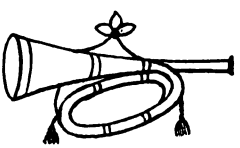


(32) Sick Berth Staff (red cross on white ground in gold circle on cloth; red cross on white ground in red circle on serge; red cross on white ground in blue circle on drill).



Sick Berth Ratings of special qualifications, viz., Laboratory Attendants, Masseurs and Operating Room Attendants, wear badges consisting of the above design surmounted by the letter L, M, or O, as the case may be.

(33) Bugler.



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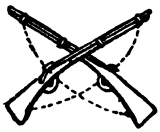
(34) Good Shooting Badge, 1st class Marksman.

(35) Good Shooting Badge, 2nd class Marksman.



(36) Good Shooting Badge, 3rd class Marksman.

NOTE.—Good shooting badges are worn for 12 months from date of receipt of badge, or until the wearer again undergoes an annual course if under 12 months.

Time.

The day of 24 hours is divided into seven watches, viz. :—

Noon to 4 p.m.—afternoon watch.
4 to 6 p.m.—1st dog watch.
6 to 8 p.m.—2nd dog watch.
8 to midnight—1st watch.
Midnight to 4 a.m.—middle watch.
4 a.m. to 8 a.m.—morning watch.
8 a.m. to noon—forenoon watch.

The reason for introducing the two dog watches between the hours of 4 p.m. and 8 p.m. is to make an odd number of watches in the 24 hours, thus making the men change their watches every day.

Time is denoted on board ship by striking a bell every half hour. The rule being :—One stroke of the bell at half-past four, half-past eight, and half-past twelve, one more stroke being added for each half-hour until eight strokes

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of the bell or eight bells are reached at four, eight, and twelve. The dog watches are different, 6.30 p.m. being one bell, 7 p.m. two bells, and 7.30 p.m. three bells, but eight o'clock is always eight bells.

Seamen Watches.

Seamen, when serving in a commissioned ship, are divided into two watches :—

Starboard and Port.

Each watch is divided into two "parts" (1st part, 2nd part), and each part into two "sub-divisions."

Each watch is divided into four "parts of the ship" :—

Forecastlemen, Foretopmen, Maintopmen, Quarterdeckmen.

(In some ships the King's Company are divided into three watches instead of two, and have three parts of the ship :—Forecastlemen, Topmen, and Quarterdeckmen.)

At Sea.—One watch or part of a watch is always on deck night or day.

In Harbour.—Both watches are on deck during working hours, after which the watch on board is used for any work that may be necessary.

Different portions of the ship are detailed off to each part for cleaning purposes, closing W.T. doors, &c.

The following duties are, as a rule, required to be carried out by the watch on deck when a ship is at sea—and are called "tricks."

Tricks.

Lookouts.—By day, that is from daylight to sunset, a lookout man is stationed at the masthead or in the top. The duty of this masthead man is to keep a lookout for and report to the Officer of the Watch all vessels, land, lighthouses, shoal water, rocks, wrecks, or anything unusual which he sights, stating the bearing of the object. He is relieved hourly, and after being relieved reports to the Officer of the Watch, "Masthead man relieved," and what the object is in sight and the bearing, or that nothing is in sight.

By night, from sunset to daylight, lookouts are stationed on the bridge to carry out the same duty as the masthead man by day. They also see that the bow and steaming lights are burning brightly and report if they are not. They are relieved every hour and report to the Officer of the Watch that they have been relieved, what is in sight, and that the lights are burning brightly.

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They report every time the bell strikes by singing out "Starboard lookout" or "Port lookout" as the case may be. In a fog, falling snow or thick weather, lookouts are also placed. In a fog, one is placed low down and another high up, as it may be possible to see over or under the fog. It is most important that a strict and thorough lookout should always be kept. Lookouts must never leave their posts unless properly relieved or ordered to do so by the Officer of the Watch.

They must always point out to their reliefs all objects in sight.

Helmsman.—The helmsman's duty is to steer the ship under the supervision of the Quartermaster. He is relieved every two hours, and informs his relief of the course he is steering and the amount of helm that the ship is carrying. The Course by the steering compass and also by the Standard compass is usually marked on a slate or board hung near the binnacle.

Flag and Conemen.—When under weigh in company with other ships, men are stationed to work the revolution flags and speed cone on each side of the bridge. When entering or leaving harbour or manœuvring, two men are stationed each side; at other times it is usual to have one.

At Night.—These men work the speed lights instead of flags and cones.

They are relieved every hour.

Telegraphmen.—Are stationed at the engine room telegraphs. They work them as ordered by the Officer of the Watch.

When the engine room telltales are connected up, the telegraphmen report when each order to the engine room has been carried out, *e.g.*, "Starboard engine going astern," &c.

Messenger.—A man is stationed on the bridge to take messages as necessary. The messengers work in four watches.

Leadsmen.—Are placed in the chains, when near to or approaching land. They are relieved every hour or more frequently if the weather is such as to make it necessary.

Sentry on Lifebuoy.—When the ship is under weigh, a sentry is placed on the lifebuoy. His duty is to let it go when a man falls overboard.

Seaman Gunner of the Watch.—The seaman gunner of the watch places a rocket ready for firing at sunset; sees the signal guns cleared away and the ammunition placed in the position ordered for it in rear of the gun. He reports at sunset that this has been done.

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Carpenter of the Watch.—A carpenter rating is told off as carpenter of the watch. His duty is to go round the ship every two hours and see that she is not making any water. He reports to the Officer of the Watch.

L.T.O. of Watch.—One or more torpedo ratings are told off as L.T.O. of the watch. They repair any small defects to electrical gear which may occur, and look after electric motors, &c., which are running.

Sea-boat's Crew.—Consists of a cutter's crew taken from the watch on deck. They are always to be on the upper deck and ready to man either sea-boat instantly. They fall in separately when the watch or both watches fall in.

A second sea-boat's crew is also told off from the watch, so that the other sea-boat may be quickly manned if required.

Sea-boat Lowerers.—A Leading Seaman of the Fore and Maintop and two hands of each of these parts of ship are sea-boat lowerers. They muster with the sea-boat's crew.

Ash Party.—In ships which have no ash ejectors, it is necessary to get up ashes from the stokehold at least once a watch. This is done by a party of men from the watch on deck. In large ships, when steaming at a moderate speed, eight hands and a leading hand are required.

Sounding Party.—Two hands and a leading hand are told off in each watch as a sounding party to work the sounding machine. They are piped to do so as required. When it is required to keep the sounding machine going constantly they are relieved as necessary.

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CHAPTER II.

SIGNALS.

RELATIVE TO THE ORIGIN OF THE UNION FLAG IN ITS PRESENT FORM.

Union Flag.

The original National Flag of England was the Banner of St. George (argent, a cross gules) to which the Banner of St. Andrew (azure, a saltire argent) was united, in pursuance of a Royal Proclamation, dated 12th April, 1606,* of which the following is an extract:—

"Whereas some difference hath arisen between Our "Subjects of South and North Britain, travelling by "seas, about the bearing of their flags: for the avoiding "of all such contentions hereafter, We have, with the "advice of Our Council, ordered that from henceforth, "all Our subjects of this Isle and Kingdom of Great "Britain, and the members thereof, shall bear in their "maintops the Red Cross, commonly called Saint George's "Cross, and the White Cross, commonly called Saint "Andrew's Cross, joined together, according to a form made "by Our Heralds, and sent by Us to Our Admiral, to be "published to Our said subjects: and in their foretops "Our subjects of South Britain shall wear the Red Cross "only, as they were wont; and Our subjects of North Britain "in their foretops the White Cross only, as they were "accustomed."

Union with Scotland.

On the 17th March, 1706–07, the Lords of the Committee of the Privy Council ordered the Kings of Arms and the Heralds to consider of the alterations to be made in the

* Note.—A Jack is a Flag to be flown only on the "Jack" staff, *i.e.*, a staff on the bowsprit or forepart of the ship. It is believed that the term "Jack" is derived from the abbreviated name of the reigning Sovereign, King James I., under whose direction the flag was constructed, and who signed his name "Jacques." Another derivation may have been from the "Jack" or leather surcoat worn over the hauberk from the 14th to the 17th century inclusive, and which was emblazoned with the St. George's Cross. Jack is a contraction of "Jazerine," a corruption of Ghiazerine (It.)—a clinker-built boat, the Jack being formed of overlapping plates of metal covered with cloth velvet or leather.

In 1660 the Duke of York (afterwards James II.) gave an order that the Union Flag should be worn only by the King's ships.

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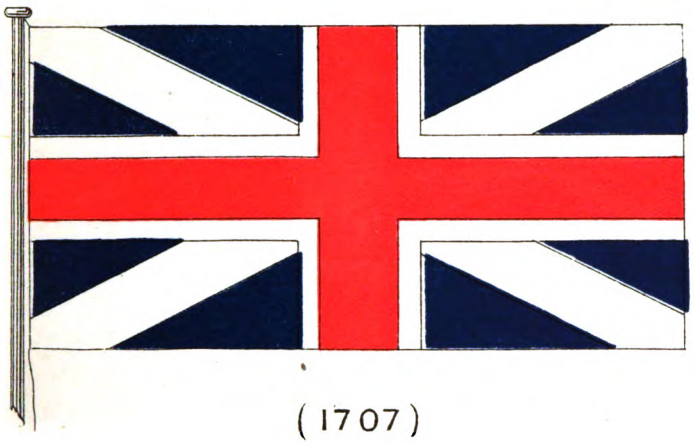
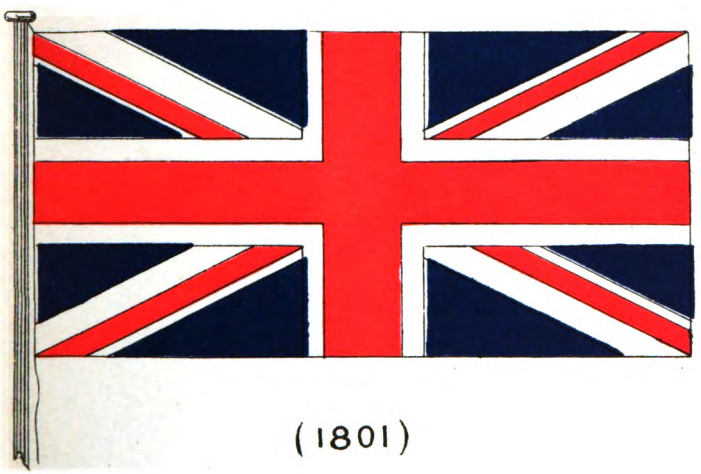
A



(1707)

B



(1801)

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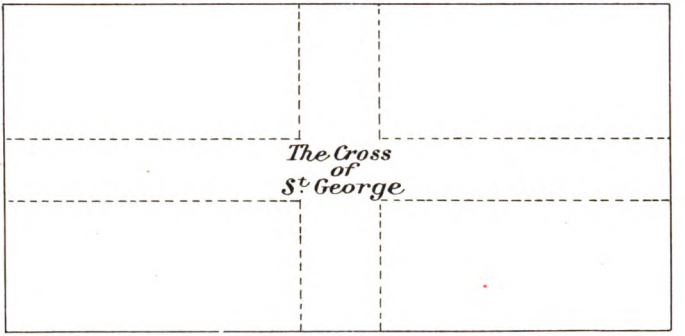

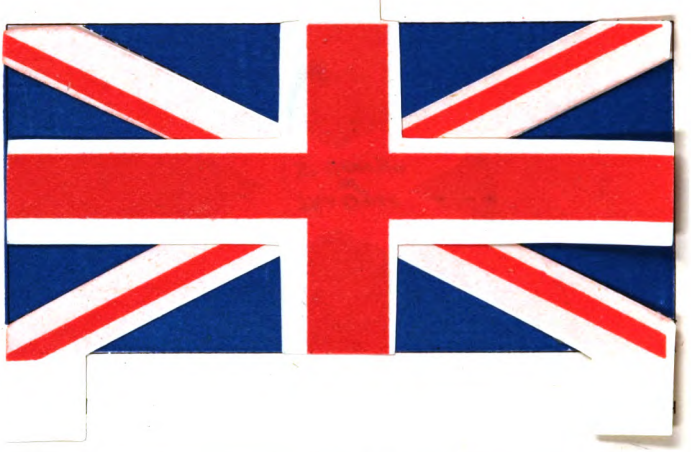

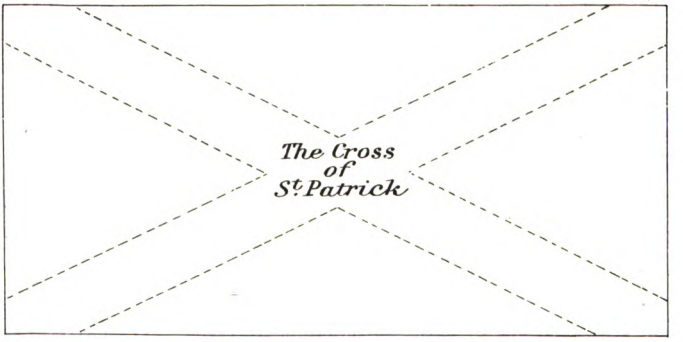

Scale of Feet.

0 1 2 3 4 5 10 15 Feet

1880

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Ensigns Armorial, and the conjoining the Crosses of St. George and St. Andrew, to be used in all flags, banners, standards and ensigns at sea and on land.

On the 17th April 1707, the Queen in Council, upon a report from the Lords of the Privy Council, who were attended by the Kings of Arms and Heralds, with divers drafts prepared by them, relating to the Ensigns Armorial for the United Kingdom, and conjoining the Crosses of St. George and St. Andrew, pursuant to the Act for uniting the two kingdoms, was pleased to approve of the following particulars (*inter alia*) "that the Flags be according to "the draft marked C, wherein the Crosses of St. George "and St. Andrew are conjoined," as shown in the following drawing marked A, which is a copy of the drawing marked C, entered in the College of Arms, with the Orders in Council.

UNION WITH IRELAND.

On the 5th November 1800 the King in Council was pleased to approve the report of a Committee of the Privy Council, that the Union Flag should be altered according to draft marked C (of which the following drawing marked B is a copy), in which the Cross of St. George is conjoined with the Crosses of St. Andrew and St. Patrick, and which is thus described in the proclamation issued on the 1st day of January 1801 :—

"And that the Union Flag shall be azure, the crosses "saltires of Saint Andrew and Saint Patrick, quarterly per "saltire counterchanged argent and gules; the latter fim- "briated of the second surmounted by the Cross of St. George "of the third fimbriated as the saltire."

On the accompanying drawing, which shows the formation of the Union Flag, turn the Cross of St. George upwards, and that of St. Patrick downwards, the banner of St. Andrew will then be uncovered; place on this the Cross of St. George, and we have the National Flag of 1606; turn back the St. George, then place the Cross of St. Patrick on the blue field of the St. Andrew's Banner (counterchanging the white bars of the Cross of St. Andrew with the red bars of that of St. Patrick), place the Cross of St. George over all, and we have the Union Flag of 1801, and of the present time.

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AS TO RED, WHITE, AND BLUE ENSIGNS.

In 1687, an inquiry was made by Mr. Pepys, Secretary to the Admiralty, as to the flags worn in the reign of Charles I.; and in a manuscript in the British Museum, it is stated, that in the Duke of Buckingham's expedition to the Isle of Rhé, in 1627, the Fleet was divided into the Red, Blue, and White Squadrons. The following is an extract from that manuscript:—

"The Duke, now lying at Portsmouth, divided his Fleete "into Squadrons. Himselfe Admirall and Generall in Chiefe "went in ye Triumph bearing the Standard of England "in ye maine topp, and Admirall particular of the bloody "colours.

"The Earle of Lindsey was Vice-Admirall to the Fleete "in the Rainbowe, bearing the King's usual colours in his "fore topp, and a Blew Flag in his maine topp, and was "Admirall of the blew colours.

"The Lord Harvey was Rear Admirall in ye Repulse, "bearing the King's usual colours in his mizen and a White "Flag in the maine topp, and was Admirall of ye Squadron "of white colours."

There were two other squadrons, one under the Earl of Danby with the St. George's Flag, the other under Captain Pennington (made Admiral of his Squadron), with the St. Andrew's Cross.

It will be observed that in this instance the Blue Flag took precedence of the White.

In 1665, in the large Fleet commanded by the Duke of York in person, as Lord High Admiral, Prince Rupert was Admiral of the White Squadron, and Sir Thomas Allen of the Blue; and an old drawing shows the three divisions of the Fleet wearing ensigns of their respective colours.

But, although the large Fleets were thus divided, Admirals on Foreign Stations continued to wear the Union Flag at the main, fore, or mizen, according to their rank as Full, Vice, or Rear-Admiral.

Many instances are mentioned of the inconvenience arising from the use of the Royal Flag by private ships, and in 1660 the Duke of York gave an order that the Union Flag should be worn only by the King's ships.

It is clear that the sole object for which the three colours were formerly used was to distinguish the divisions of the Fleet, which often numbered as many as 200 sail.

A variety of ensigns much increases the danger of confusion in action, and it may be observed that, in order to prevent that confusion, Lord Nelson, on going into action at Trafalgar, ordered the whole of his Fleet to hoist the

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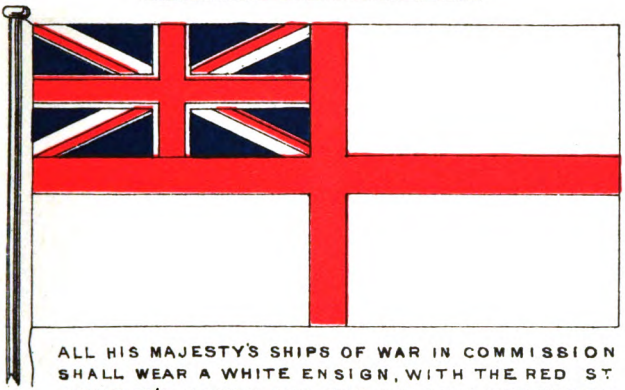
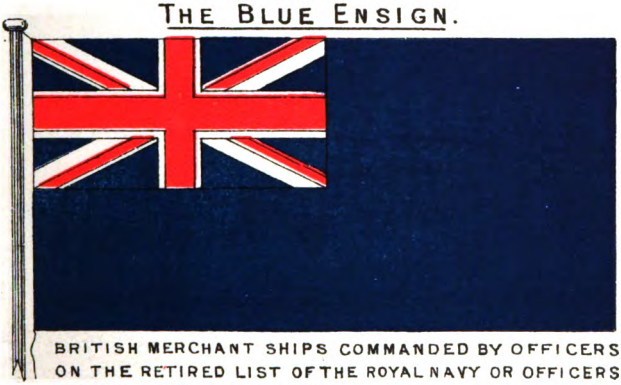
THE WHITE ENSIGN.



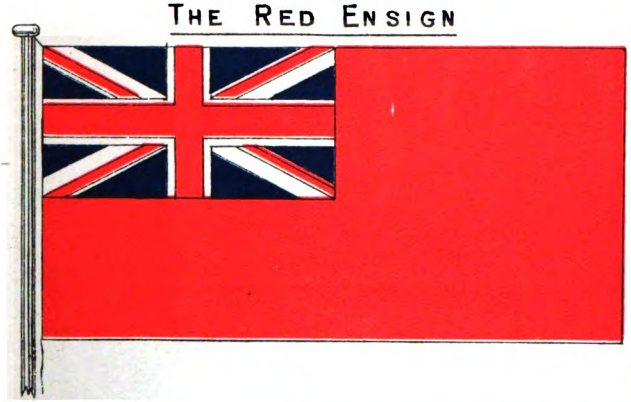
ALL HIS MAJESTY'S SHIPS OF WAR IN COMMISSION SHALL WEAR A WHITE ENSIGN, WITH THE RED ST GEORGE'S CROSS AND THE UNION IN THE UPPER CANTON.

THE BLUE ENSIGN.



BRITISH MERCHANT SHIPS COMMANDED BY OFFICERS ON THE RETIRED LIST OF THE ROYAL NAVY OR OFFICERS OF THE ROYAL NAVAL RESERVE, UNDER CERTAIN CONDITIONS, WILL BE ALLOWED TO WEAR A BLUE ENSIGN.

THE RED ENSIGN



1860

H. & C. Graham, Ltd. Litho, London

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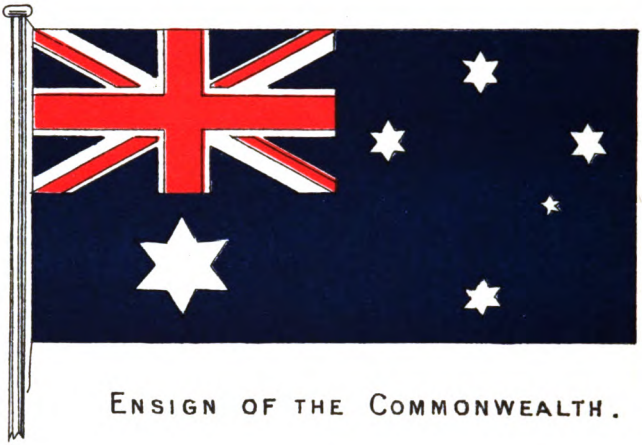
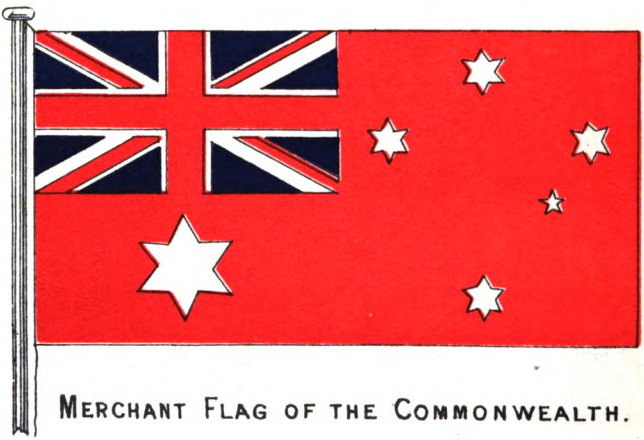
AUSTRALIA.



ENSIGN OF THE COMMONWEALTH.



MERCHANT FLAG OF THE COMMONWEALTH.

1880

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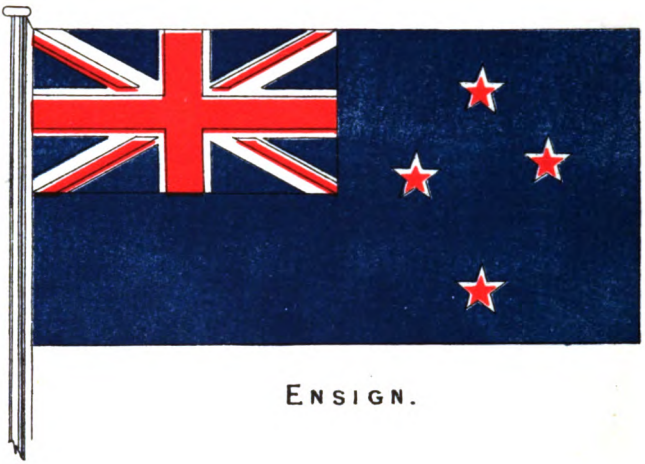
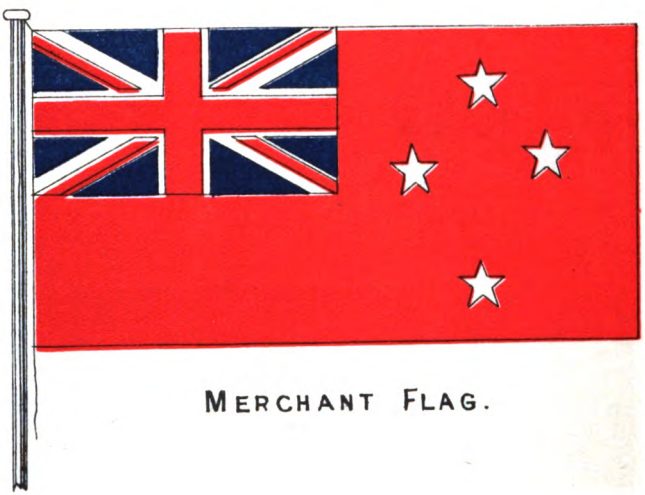
NEW ZEALAND.



ENSIGN.



MERCHANT FLAG.

4880

W. & C. Graham Ltd Litho, London

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White Ensign; and it was under that flag, the "Old Banner of England," but with the Union in the upper corner, that the victory was gained.

Latterly, owing to the comparatively small number of ships forming a fleet, the distinctive colours became of much less importance, while the frequent change of flags on foreign stations was very puzzling to foreigners, often led to mistakes, and in many ways was inconvenient; accordingly, on the 9th of July 1864, by Her Majesty's Order in Council of that date, it was directed that the classification of ships under the denominations of Red, White and Blue Squadrons, should be discontinued, and that in future the "White" Ensign should be used by all of H.M. ships of war in commission; the Blue Ensign by British merchant ships commanded by officers of the Royal Navy Reserve, after obtaining permission from the Admiralty; and the Red Ensign by all other ships and vessels belonging to H.M. subjects.

All other ships and vessels which belong to His Majesty's subjects shall wear a Red Ensign free from any badge or distinctive mark, with the Union in the upper canton next the staff, except such yachts or other vessels as may have warrants from the Admiralty to display other ensigns.

The following are the regulations as to the flags to be worn by any vessel maintained by any colony under the Colonial Defence Act of 1865:—

(*a*) Any vessel provided and used as a vessel of war, shall wear the Blue Ensign with the badge of the colony in the fly thereof, and a Blue Pendant.

(*b*) All vessels belonging to or permanently in the service of the colonies, but not commissioned as vessels of war under the Act, shall wear a similar Blue Ensign but no Pendant.

Ships and vessels employed in the service of any public office shall carry a Blue Ensign, and a small Blue Flag with a Union described in a canton at the upper corner thereof next to the staff, as a Jack; but in the centre of the fly of such Ensign and Jack, that is in the centre of that part between the Union and the end of the flag, shall be inserted the badge of the office to which they belong.

Hired transports are to wear the Blue Ensign with the yellow Admiralty anchor in the fly; and when such vessels are in charge of commissioned officers of the Royal Navy, they are, in addition, to carry Blue Pendants with

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the Admiralty badge in the upper part next to the mast.

Hired vessels employed in the Surveying Service, when commanded by officers in His Majesty's Navy, are to wear the Blue Ensign and Pendant.

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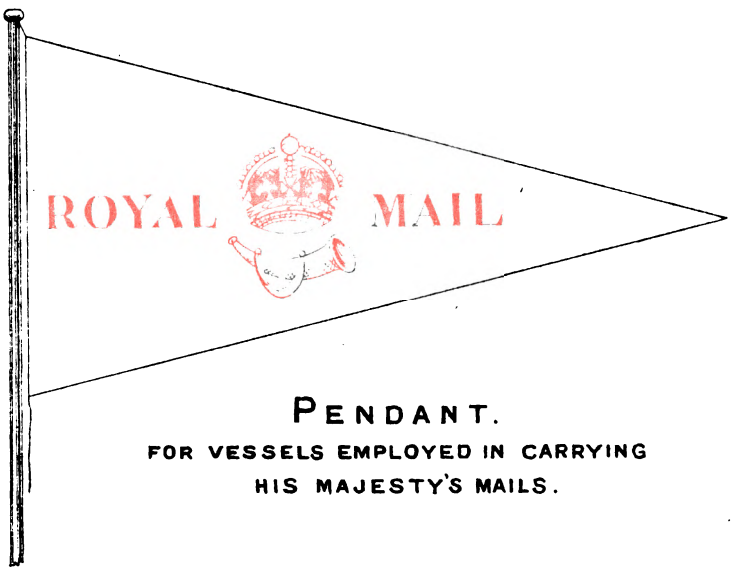

PENDANT.

FOR VESSELS EMPLOYED IN CARRYING
HIS MAJESTY'S MAILS.

1880

H. & C. GRAHAM Lᵗᵈ LITHOS, LONDON S.E.

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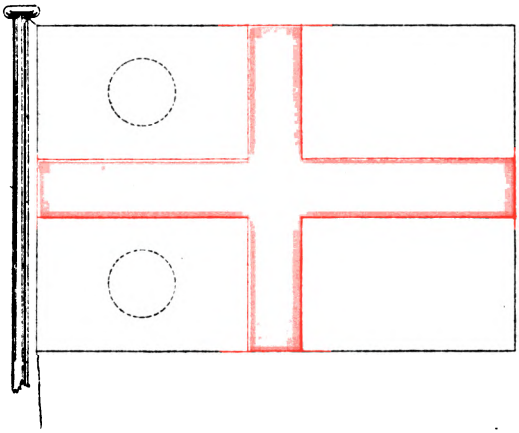
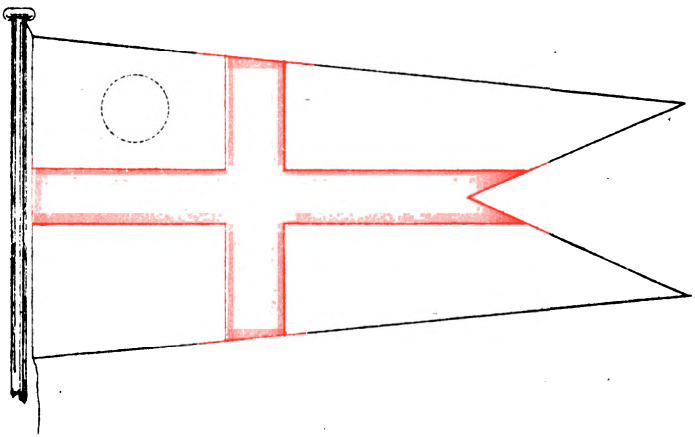
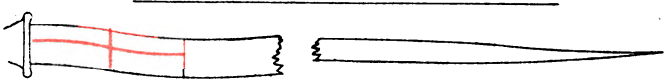
Flags worn by Flag Officers.





The Masthead Pendant.



1880

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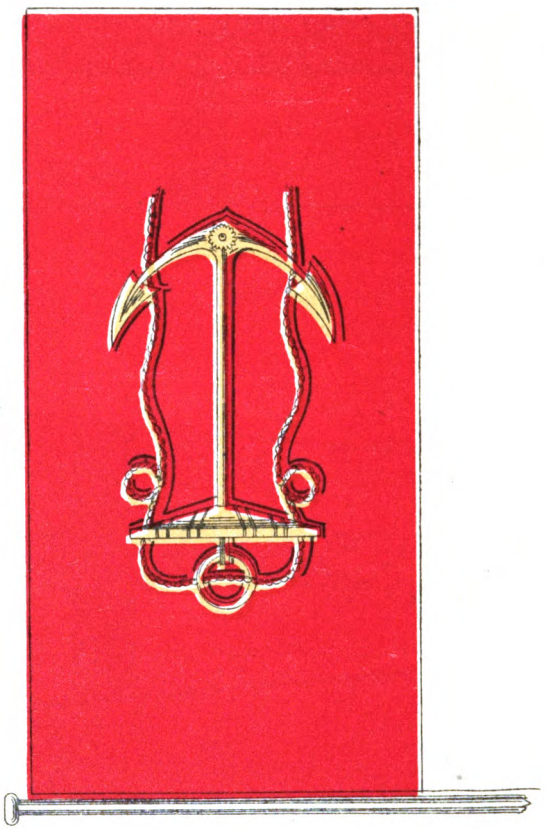
Lord High Admiral or Admiralty Flag.



1880

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Standard of H.M. Queen Alexandra.

W. & C. GRAHAM, LTD., LITH., LONDON, S.E.

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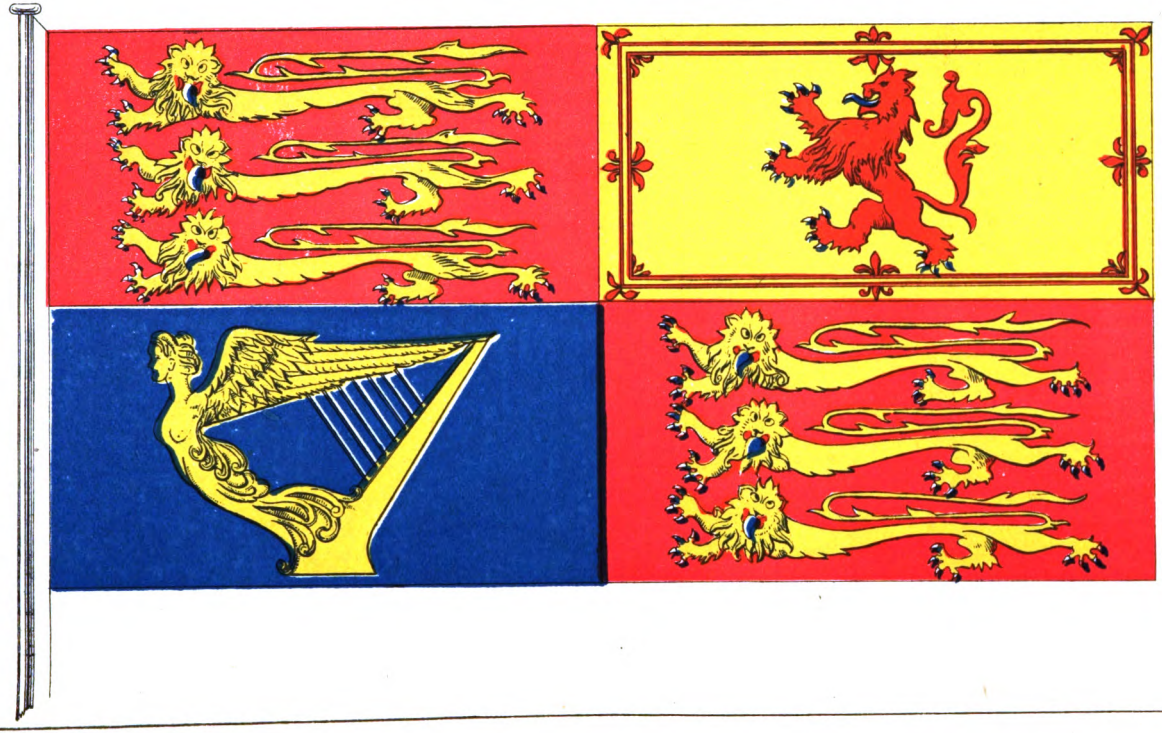
THE ROYAL STANDARD.



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To face page 31 (1)

THE ROYAL STANDARD.

The Royal Standard is the personal flag of the Sovereign.

It is only hoisted on board a ship on occasions when the Sovereign is actually present.

Whenever the Sovereign shall go on board any ship of war the Royal Standard shall be hoisted at the main, the Flag of the Lord High Admiral at the fore, and the Union Flag at the mizen of such ship; or if on board a vessel with less than three masts, they shall be hoisted in the most conspicuous parts of her.

When Her Majesty the Queen, the Queen Mother or the Prince of Wales, is embarked in any ship or vessel Her or his Standard shall be hoisted at the main, and it shall be treated with the same respect and saluted in the same manner as the flags denoting the presence of the Sovereign.

OTHER ROYAL STANDARDS.

Personal standards are also appropriated for the use of:—

(i) The Queen.

(ii) The Queen Alexandra (Queen Mother) (*see* plate).

(iii) The Prince of Wales.

(iv) The Duke and Duchess of Connaught.

(v) Prince Arthur of Connaught.

(vi) Other Members of the Royal Family.

Pictures of the last four standards are to be found in the "Flags of all Nations" book, which is supplied to ships.

ADMIRALTY AND ADMIRALS' FLAGS.

The Lord High Admiral's Flag is to be worn in ships in which the Lord High Admiral or the Commissioners for executing the office of Lord High Admiral are embarked.

Admiral of the Fleet:—The Union Flag is to be worn at the main by an Admiral of the Fleet as his proper flag.

The flag worn by an Admiral:—A white flag with the red St. George's cross thereon.

The flag worn by a Vice-Admiral:—The same flag as above, with one red ball in the upper canton of the flag next the staff.

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The flag worn by a Rear-Admiral:—The same flag as above, with one red ball in the upper canton and one in the lower canton next the staff.

THE BROAD PENDANT OF A COMMODORE.

A Commodore of the 1st Class shall wear a white broad pendant with a Red St. George's Cross thereon.

A Commodore of the 2nd Class:—The same flag as above, with a red ball in the upper canton of the broad pendant next the staff.

SENIOR OFFICERS' AND COMMISSION PENDANTS.

When two or more of H.M. ships are present in a port or roadstead a small broad white pendant with the Red St. George's Cross is to be hoisted by the Senior Officer's ship at the starboard topsail yard-arm as a distinguishing flag in addition to the masthead pendant.

All H.M. ships in commission when not bearing a flag or broad pendant are to wear at the main masthead a pendant as above.

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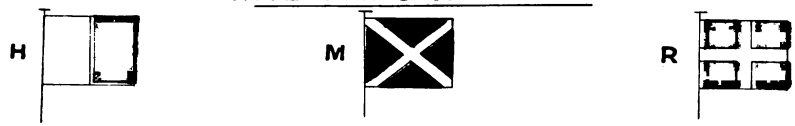
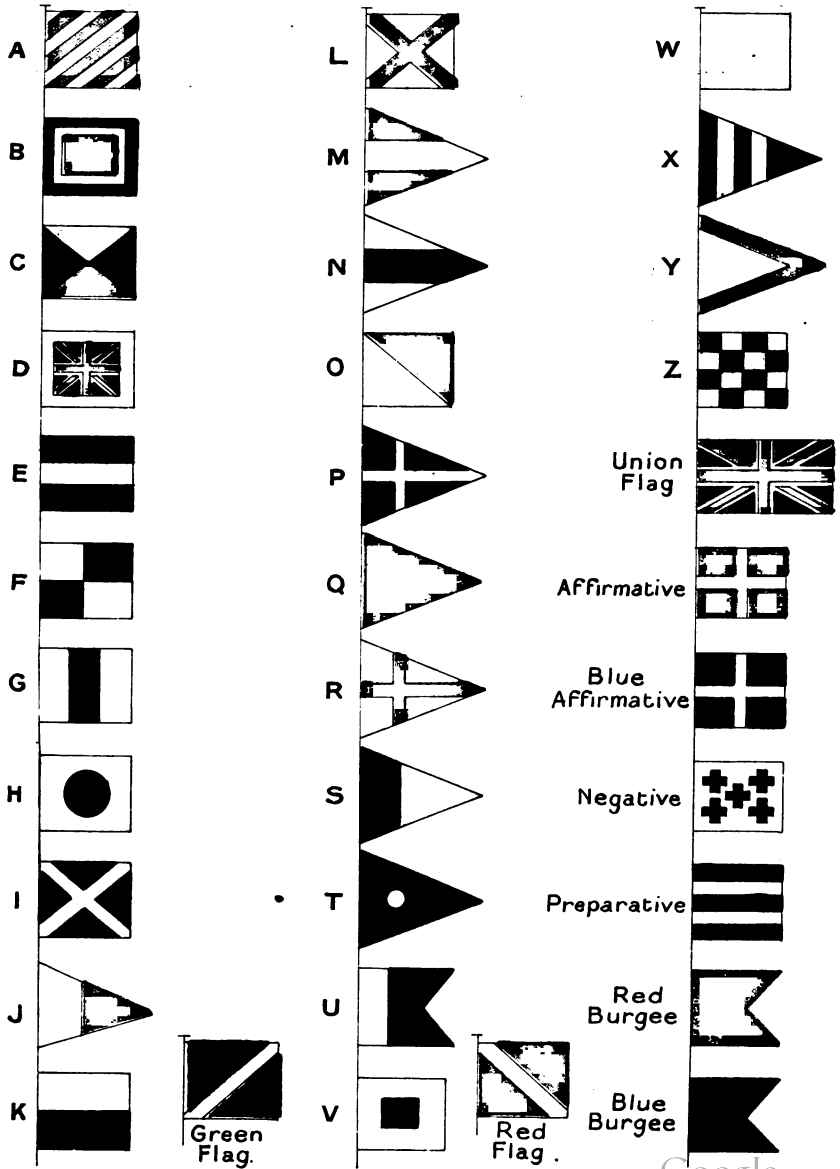
FLAGS AND PENDANTS USED IN NAVAL SIGNALLING

INTERNATIONAL FLAGS.



ALPHABETICAL FLAGS AND SPECIAL FLAGS.



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1890

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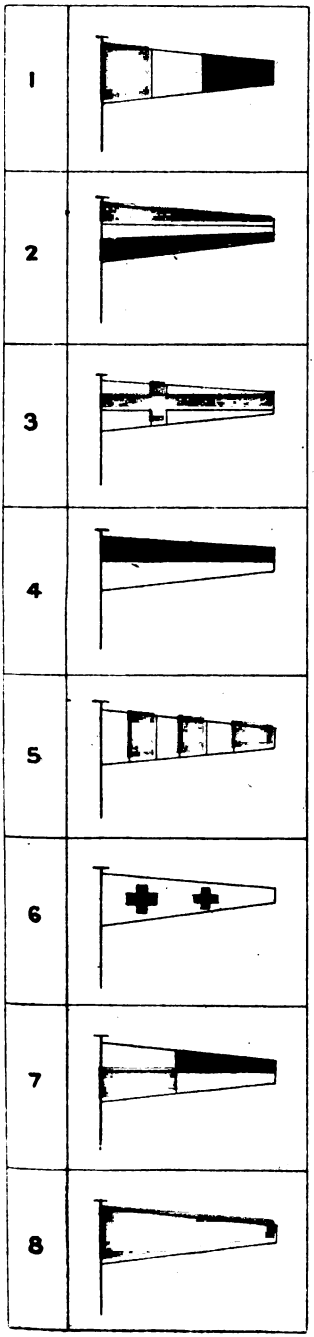
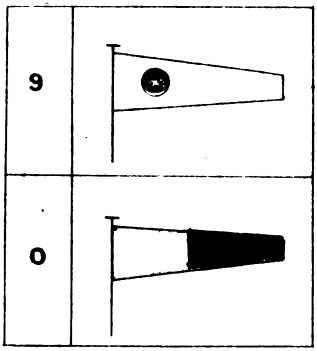
FLAGS and PENDANTS used in NAVAL SIGNALLING

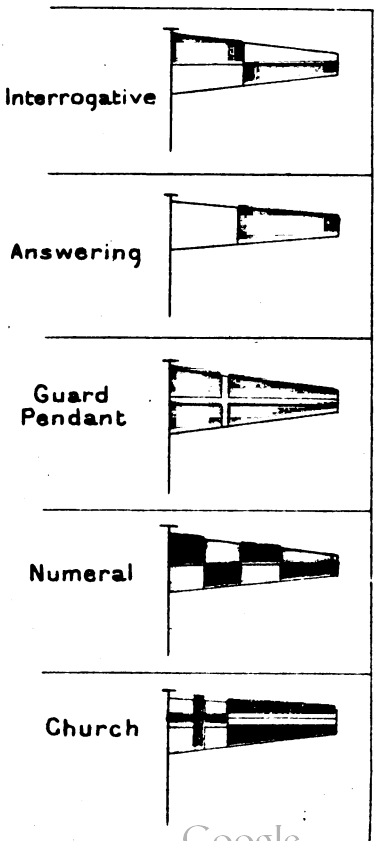
NUMBERED PENDANTS



NUMBERED PENDANTS



SPECIAL PENDANTS AND ALTER COURSE PENDANTS.



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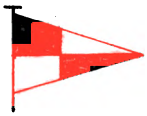
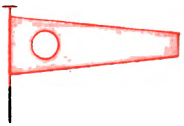
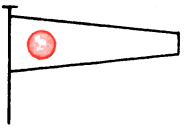
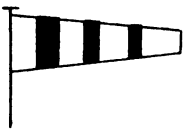
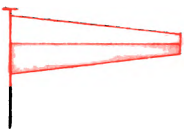
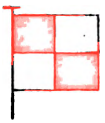
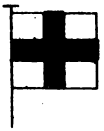
FLAGS AND PENDANTS USED IN NAVAL SIGNALLING.

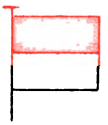
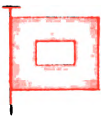
SPECIAL PENDANTS AND ALTER COURSE PENDANTS (Contd)

Fishery Duty Pendant	
Compass or Red Pendant	
Blue Pendant	
Nine Pendant	
Equal Speed Pendant	
Oblique Pendant	

NUMERAL FLAGS

1	
2	

NUMERAL FLAGS (Contd)

3	
4	
5	
6	
7	
8	
9	
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To face page 3214

SUBSTITUTES.

FOR FLAGS

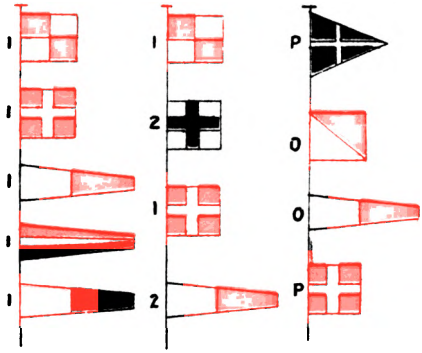
(AFFIRMATIVE)
FIRST SUBSTITUTE

(ANSWERING PENDANT)
SECOND SUBSTITUTE

(No 2 PENDANT)
THIRD SUBSTITUTE

(No 0 PENDANT)
FOURTH SUBSTITUTE

EXAMPLES.



IIIII. 1212 POOP

FOR PENDANTS

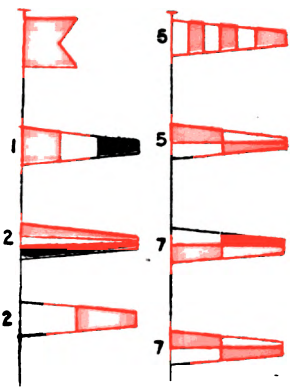
(INTERROGATIVE PDT.)
FIRST SUBSTITUTE

(ANSWERING PDT.)
SECOND SUBSTITUTE

THE 1ST SUBSTITUTE ALWAYS REPEATS THE UPPER FLAG OR PENDANT OF A "SERIES," THE 2ND SUBSTITUTE REPEATS THE SECOND FLAG OR PENDANT, THE 3RD SUBSTITUTE REPEATS THE THIRD FLAG, AND THE 4TH SUBSTITUTE REPEATS THE FOURTH FLAG

NOTE:- THE NUMERAL, LATITUDE, LONGITUDE AND HORARY PENDANTS WHEN HOISTED BETWEEN NUMERAL FLAGS ARE NOT TO BE CONSIDERED AS BREAKING THE "SERIES"

EXAMPLES



TORPEDO BOAT No 122

SHIPS HOLDING 55 & 77 PENDANTS

DEFINITION OF "SERIES"

TWO OR MORE CONTIGUOUS FLAGS OR PENDANTS OF THE SAME CLASS IN ANY HOIST, WHICH IN THEMSELVES COMPOSE A SEPARATE SIGNAL ARE TERMED A "SERIES"

H & C. GRAHAM LTD LITHOS LONDON S.E

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Measurement of Ensigns, Standards, &c.

The size of British Ensigns, Standards, and Union Flags is commonly expressed in terms of "breadths." This measurement, which is 9 inches, was originally that of the width of a cloth of bunting, and it is still used for describing the size of any of the above flags, although bunting is now supplied in widths of 18 inches.

In the Union Flags, Standards, and the White, Blue, and Red Ensigns the length is twice the breadth. In the Admirals' Flags the length is 1½ times the breadth.

When the size of one of the above flags is spoken of as, say, "16 breadths," it denotes that it is 16 × 9 inches (or, 12 feet) broad and, as it is twice as long as it is broad, 24 feet long.

Each cloth of bunting (18 inches in width) has a few thicker threads worked not only into its edges, but also at every 6 inches of its warp,* and this mark shows the bunting to be of Government make.

Hoisting and Hauling down the Ensign.

1. H.M. ships when at anchor in Home ports and roads shall hoist their ensigns at 8 o'clock in the morning from 25th March to 20th September inclusive, and at 9 o'clock from 21st September to 24th March inclusive; but when abroad, at 8 or 9 o'clock, as the Commander-in-Chief shall direct, and they shall be kept flying, if the weather permit, or the Senior Officer present see no objection thereto, throughout the day until sunset, when they are to be hauled down.

2. Whenever a ship shall come to anchor or get under way, if there be sufficient light for the ensign to be seen, it is to be hoisted, though earlier or later than aforesaid; also on her passing, meeting, joining, or parting from any other of H.M. ships; and also, unless there should be sufficient reason to the contrary, on her falling in with any other ship or ships at sea, or when in sight of and near the land, and especially when passing or approaching forts, castles, batteries, lighthouses, or towns.

Descriptions of other National Flags.

In a book entitled "Flags of all Nations," which is supplied to H.M. ships, will be found pictures of all flags

* NOTE.—The *warp* threads are those which are longitudinal to the cloth of bunting, the *weft* are those which are woven by the shuttle at right-angles between them.

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officially authorised to be flown by ships of different nationalities.

NAVAL CODE OF SIGNAL FLAGS.

The flags and pendants shown in the preceding plates comprise the Naval Code used for signalling. They are made in six different sizes, and are supplied according to the size of the ship and for different purposes.

Shape of Flag.	Size :	1.	2.	3.	4.	5.	6.
		′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
Rectangular flags.	Length	11 0	9 0	7 6	5 0	4 0	2 6
	Breadth	9 0	7 6	6 0	3 9	3 4	2 0
Triangular flags.	Length	15 0	11 0	9 6	6 8	5 0	2 9
	Breadth	11 0	9 6	7 6	4 7	3 11	2 6
Pendants	Length	22 0	20 0	15 6	9 2	8 0	5 0
	Breadth at head.	6 9	5 9	4 9	3 2	2 3	1 4
	Breadth at fly.	2 0	1 6	1 3	0 10	0 6	0 4

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INSTRUCTIONS RELATING TO SEMAPHORE.

I.

The Semaphore Flag.

Flag E hoisted singly, or inferior to distinguishing signals, denotes that a communication is about to be made by semaphore, the arms of which are, at the same time, to be set to the sign required.

II.

Method of Answering.

The Answering Pendant is to be hoisted at the dip immediately the ship or ships addressed see the signal and close up when they are ready to read and write down. It is to be dipped when a word is lost; and the ship making the signal is then to repeat preceding words until the Answering Pendant is again hoisted close up.

III.

In a boat, when the Answering Pendant is used on a stick or boat-hook, it is to be held in a perpendicular position for close up, and just above the horizontal to represent the dip.

IV.

Special Signs.

A semaphore signal is commenced with the Alphabetical sign.

The Alphabetical Sign is also to precede each distinct message.

The Numeral Sign is always to precede signs on the semaphore when they represent numbers.

The Annul Sign denotes that the word or group immediately preceding it is erased; the Alphabetical or Numeral Sign will then be made, followed by the last word, or group, sent correctly and the message continued.

If after a message has been concluded it is required to alter any particular word or words, the Annul Sign will be made followed by the words to be erased, and then the Alphabetical or Numeral Sign followed by the correct word or group.

Should it be required to cancel the whole message, the Annul Sign followed by the word "All" is to be made.

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In order to render the text of a message to be semaphored perfectly clearly, the following Signs are to be made use of :—

Full stop – – – –	**A A A**
Tack Line or Break Sign – –	**I I**
Words to be in parentheses – –	**K K**
Words to be underlined – – –	**U K**
Words to be in inverted commas –	**R R**

Any other signs used in the Post Office Morse may also be used if required.

NOTES ON SEMAPHORE INSTRUCTION.

On the opposite page will be seen the various positions the arms should assume for semaphoring the different letters, &c.

One great advantage of this system is that it can be learnt with great rapidity, and a very moderate amount of practice enables anyone to read a message at a fairly rapid rate.

The simplest method of learning the alphabet and other signs is by circles, thus :—

1st Circle.—**A** to **G** (Single Signs).

2nd Circle.—**H** to **N,** omitting **J.**

3rd Circle.—**O** to **S.**

4th Circle.—**T U Y** and "**Annul.**"

5th Circle.—"**Numeral,**" **J** (or "**Alphabetical**") and **V.**

6th Circle.—**W** and **X.**

7th Circle.—**Z.**

In the first circle the letters **A** to **C** inclusive are made with the right arm, **E** to **G** with the left, letter **D** being made with either the right or left arm as most convenient to the sender. In the second circle the right arm should be kept stationary at letter **A,** the left arm being used for completing the sign. Thus, letter **L** is made by the right arm at letter **A,** and the left at **E.** Similarly, in the remaining circles the right arm is kept at the standing position peculiar to the circle, while the left arm completes the entire sign.

The sender cannot make his signs too accurately. The arm, wrist, and hand-flag should invariably form one continuous straight line, the arms moving from sign to sign by the shortest route. The tendency to bend the

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[*To face page* 36.

SEMAPHORE SIGNS AND SIGNIFICATIONS.

A & I	B & 2	C & 3	D & 4	E & 5
F & 6	G & 7	H & 8	I & 9	J (ALPHABETICAL)
K & O	L	M	N	O
P	Q	R	S	T
U	V	W	X	Y
Z		ALPHABETICAL	NUMERAL	ANNUL

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elbow, which is so conducive to bad signalling, must be carefully guarded against. The hand-flags should be kept clear, and held accurately at the proper angle. In changing from one sign to another, the arms should be kept straight, and swung through a vertical plane. The sender should keep his body steady and square to the direction of signalling. The arms when disengaged should be dropped smartly and kept in front of the sender's legs. The faults of bad semaphoring generally consist of the arms being held too close to the body for **A** and **G**, not accurately horizontal for **B** and **F**, **C** and **E** not being exactly midway between the vertical and horizontal, and **D** not being formed by the arm and hand-flag being exactly vertical from the shoulder-blade.

In learning the semaphore by the circles, the beginner should be practised to make the letters out of alphabetical order, and should thoroughly master the letters in this manner (without having to think, for instance, that letter **D** is the third position) before proceeding to learn the letters belonging to the next circle.

In semaphoring to another ship the sender must always get in a conspicuous position and choose a background which is as far away as possible, bearing in mind that a sky-line affords the best relief to the signs.

To hurry your letters generally means slovenly sending, inaccurate formation of signs, and delays due to repetitions being demanded. A semaphore message made at six words a minute, and correctly read the first time, is a far better performance than having to be made twice by the sender endeavouring to get the message in at 12 words a minute at the first attempt.

The Alphabetical sign shows from which side the signs are to be read, and as it is often necessary to signal in opposite directions by the same semaphore, signalmen must be careful to observe in which direction the sender is facing, more especially if he is using hand flags, so that they can tell the side from which they must read the signs from their point of view. It should be noted that when the Alphabetical sign is shown it is the left arm which is extended horizontally.

SIGNALLING BY FLAG-WAVING.

Semaphore signals have the great advantage that each sign is made in its entirety, and, as long as the relative position of the sender's arms can be clearly discerned, it is easy to read the letters at a good rate. A disadvantage incidental to the system is, however, that as each sign is a fixed signal, it requires a background which will afford

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sufficient relief to the arms to enable the signs to be made out at any distance. Sometimes conditions may obtain where flag signalling is impracticable, and when the background is so close or dark that the relative position of the sender's arms in semaphoring cannot be distinguished.

Such conditions may obtain when, for instance, it is desirable to signal off to a ship from the shore where a good background is unobtainable. It is then that flag-waving may be profitably employed. This results from the fact that an object in motion, such as a white handkerchief or flag waved, is naturally far more attractive for calling up, and more conspicuous for seeing, than some stationary sign as with semaphore.

The more remarkable the contrast is between the colour of the flag used and the background, the better able is the receiver to make out the signal. Consequently Morse flags are generally made of two colours, all blue, or white with a narrow blue horizontal bar, so that the one which is likely to show up best can be selected. The sender must consider the background he affords from the direction of signalling, and, all according to whether he presents himself against a dark or light background, he should use the flag of the opposite colour. The position of the sun must also be considered. As a general rule, if the sun is in front of the sender a white flag will be found most conspicuous: if the sun is behind the sender (unless the sender is himself in shadow), a blue flag would be found best.

The Morse flags mentioned above are supplied in two sizes—three feet square and two feet square. The staffs are 5 feet 6 inches and 3 feet 6 inches long respectively.

The manner of waving the flag through short and long arcs to represent dots and dashes is described below. The signaller can either face or turn his back to the direction of signalling, according to convenience or direction of the wind.

In the normal position *a* (as shown in Fig. 1), the flag should make an angle of about 25° with a vertical line through the centre of the body. The staff should be kept high enough to permit seeing underneath the flag while in motion.

To make a Dot or Short Flash the flag is waved from *a* to *b* and, without any pause, back again to the normal position *a*.

To make a Dash or Long Flash the flag is waved from *a* to *c* and then, after the slightest perceptible pause, brought back to the normal position *a*.

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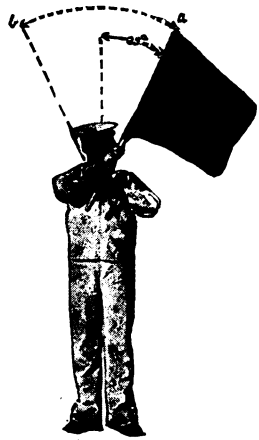

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

When Signalling a Letter the elements (dots or dashes) representing it should be made in one continuous wave of the flag, taking particular care that no pause is made when at the normal position. Thus, for example, to signal "F" (▪ ▪ ▬ ▪) the flag is waved from *a* to *b*, back to *a*, then (without a pause) to *b* again, then to *a*, and down to *c*, and after the slightest perceptible pause, back again to *a*, the normal position, to *b* and *a* again.

How to Signal.—A pause equal to the length of a *dash* should be made at the normal position *a* between each

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letter of a word or letter of a Code group. When the word or Code group is completed, the staff is to be brought in to the front of the body, and the flag at the same moment gathered in as shown in Fig. 4. A slight pause should be made at the normal position before commencing a word or Code group.

Position of the Signaller.—The signaller should stand exactly facing, or with his back to, the line of direction, according as the wind renders it most convenient. He must be careful to wave his flag in a vertical plane square to the receiver, and the pole must be kept as upright as possible while in motion, the point never being allowed to droop to the front. In order to keep the flag always exposed while waving it across the body to form the required signal, the point of the staff should be made to describe an elongated figure of 8 in the air.

FLASHING SIGNALS.

The Morse Code.

In flashing, the Morse symbols are expressed by two elements called a *Dot* and a *Dash*. These are used singly as in letters "E" (▪ one *dot*) and "T" (▬ one *dash*), or in combination, as in letters "L" (▪ ▬ ▪ ▪) or "A" (▪ ▬).

These two elements can be made in various ways. In visual signalling, by the motion of any single object which is made to appear and disappear for short and long periods of time, representing dots and dashes respectively. This method is illustrated in the flash of a lamp, heliograph, or searchlight. Flag-waving is an instance where the two elements are signalled by moving an object through small and large arcs. They can also be signalled by short and long blasts on the whistle, bugle, fog-horn, or siren. In telegraphy, these elements are recognised by short and long spaces of silence between the clicks of a sounder; by the short and long aural sounds of a buzzer; by the left and right deflections of a pointer, as in the needle instrument; or by any instrument giving sounds of two notes, such as the bell instrument, where the higher note is a dot and the lower note a dash.

In flashing, the *dots*, *dashes*, and *spaces* between them should be made to bear the following ratio one to another in the duration of time taken to send them:—

A **Dot** is taken as the unit, and a **Dash** is equivalent to three units.

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The space of time between any two elements of a letter or sign is equal to one unit, between two complete letters or signs is equal to a dash or three units, and between two words or groups two dashes or six units.

Up to ordinary limits, whatever may be the rate of sending, accuracy in signalling depends upon these rules being strictly adhered to.

Although the rules prescribed above have been found most suitable for skilled signalmen, experience has proved that a slight modification is beneficial when flashing has, of necessity, to be made at comparatively slow rates. It is then best—while generally obeying the rules given in paragraph 2—to err on the side of making the dots rather shorter than their prescribed proportion to the dashes. In fact it hardly matters how short the dot is, as long as it can clearly be seen, but if the dashes are prolonged over their proportionate length, the distinction between a dot and a dash becomes comparatively all the greater.

Again, should the receiving signalman not be a skilled signalman, it is better to allow him a longer pause between the letters than three units, taking care, of course, to proportionately prolong the space between two words or groups.

The following methods may be used for signalling :—

By day—

1. Flag-waving.
2. Heliograph!
3. Sounder, Buzzer or W/T.
4. Searchlight.

By night—

1. Lamp.
2. Searchlight.
3. Sounder, Buzzer, or W/T.

In a fog—

1. Sound signals.
2. Sounder, Buzzer, or W/T.
3. Searchlight.

The Morse Symbols.

Below are shown the Morse alphabetical signs, which in no case consist of more than four elements. The general principle underlying the composition of these signs is that those letters which occur most frequently in ordinary English prose are given the shortest symbols. Thus, for every time the letter " Q " (the Morse symbol for which is — — ▪ — 13 units) appears in ordinary English composition, the letter " E " (the Morse symbol for which is ▪ one unit) appears about 120 times.

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Morse Alphabet.

A	·—	N	—·
B	—···	O	———
C	—·—·	P	·——·
D	—··	Q	——·—
E	·	R	·—·
F	··—·	S	···
G	——·	T	—
H	····	U	··—
I	··	V	···—
J	·———	W	·——
K	—·—	X	—··—
L	·—··	Y	—·——
M	——	Z	——··

Numerals.

The following are the Morse symbols for figures :—

1. ·————
2. ··———
3. ···——
4. ····—
5. ·····
6. —····
7. ——···
8. ———··
9. ————·
0. —————

From the above, it will be observed that the symbols for figures always conform to the following rules :—

(*a*) They invariably consist of five elements—dots or dashes.

(*b*) Dots and dashes are not sandwiched ; the sign either begins with one or more dots or with one or more dashes.

Thus, when figures are signalled, the receiver can check the number by either the number of dots or dashes composing the signs ; up to 5 the figure can be arrived at by the number of dots the sign commences with, or by subtracting the number of concluding dashes from 5 ; from 6 to 0 inclusive the figure can be checked by either adding five to the number of commencing dashes, or subtracting (except in the case of 0) the number of concluding dots from 10.

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SPECIAL SIGNS.

Pendants.

"Pendant" Sign— ▪▬▬▪▬ –	– P T	Made as one sign.
Compass or Red Pendant— ▬▪▬▪▬ – – – –	– C T	
Blue Pendant— ▬▪▪▪▬ – –	– B T	
Nine Pendant— ▬▬▬▬▪▬ – – –	– 9 T	
Numeral Pendant— ▪▪▬▪▪▪ –	– F I	
Horary Pendant— ▪▪▪▪▬▬▬ – – –	– H O	
International Code Pendant— ▬▬▬▬ – – – –	– M M	
Interrogative Pendant— ▪▪▬▪▬ –	– I N T	
Church Pendant— ▪▪▬▪▬ – –	– U T	
Oblique Pendant— ▪▬▬▬▬▪ –	– W G	
Equal Speed Pendant— ▬▬▪▪▬▬ – – –	– M I M	
Guard Pendant— ▬▬▪▬▪▪ –	– G D	

Special.

Flag Sign— ▪▪▬▪▪▬▪▪ – –	– F L	Made as one sign.
Repeat Sign— ▪▪▬▬▪▪ – –	– I M I	
Erase— ▪▬▪▬▪▬▪▬ – –	– A's	
Affirmative— ▪▬▬▪▪▬▪ – –	– A F	
Negative— ▬▪▬▬▬ – –	– N O	
Stationing (Blue Burgee)— ▬▪▪▪▬▪▪▪ – – –	– B B	
Red Burgee— ▪▬▪▬▬▪▪▪ – –	– R B	
Understand— ▪▪▪▬▪ – –	– V E	
Preparative— ▬▬▬▪ – –	– O E	
Silence— ▪▪▪▪▬▬▪▪▪▪▬▬ – –	– H M's	
Negative Silence— ▪▪▬▬▬▪▪▬▬▬ –	– U O's	
Numeral Sign— ▪▪▬▪▪▪ – –	– F I	
Spelling Sign— ▪▪▬▬▪▪▪▬▪ –	– F F	
General Call— ▪▪▪▪▪▪▪▪▪▪ – –	– E's	
Answering Sign— ▬▪▬▪▬▪▬▪ – – –	– N's	
General Stop— ▬▬▬▬ – –	– T's	

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Special Signs—*cont.*

Urgent Sign— ▬ ▬ ▬ ▬ ▬	O's		– ▬	Made as separate letters.
Tack Line Sign— ▪ ▪ ▪ ▪	–	–	– Two I's	
British Signal Manual Sign— ▬ ▪ ▬ ▪ ▬ ▪ ▪	–	–	– D's	
Special Answering Sign— ▪ ▬ ▬ ▪ ▬ ▬ ▪	–	–	– W's	
Military Sign— ▬ ▪ ▪ ▬ ▬ ▪ ▬		–	– X's	
Boat's Sign— ▬ ▪ ▪ ▪ (followed by certain Pendants)			– B	

Punctuation, etc.

Apostrophe (')— ▪ ▬ ▬ ▬ ▬ ▪	–	–	– W G	As one sign.
Hyphen (-)— ▬ ▪ ▪ ▪ ▪ ▬	–	–	– D U	
Exclamation (!)— ▬ ▬ ▪ ▪ ▬ ▬		–	– M I M	
Bar Sign (—)— ▬ ▪ ▪ ▬ ▪	–	–	– N R	
Fraction Sign— ▬ ▬ ▬ ▬	–	–	– M M	As separate letters.
Parenthesis ( )— ▬ ▪ ▬ ▬ ▪ ▬		–	– K K	
Underline (_)— ▪ ▪ ▬ ▬ ▪ ▬		–	– U K	
Inverted Commas (" ")— ▪ ▬ ▪ ▪ ▬ ▪			– R R	
Full Stop (.)— ▪ ▬ ▪ ▬ ▪ ▬	–	–	– A A A	
Cypher Sign— ▬ ▪ ▬ ▪ ▬ ▪ ▬ ▪		–	– C C	

Notes on Learning the Morse Alphabet.

Experience has shown that the best method to learn the Morse Alphabet is to take the symbols in their alphabetical order and to thoroughly master a few at a time. Thus, the beginner may divide the alphabet into series of six for each lesson; the first lesson being from **A** to **F** inclusive. When those letters have been thoroughly mastered, the next six (**G** to **L** inclusive) should be learnt. Before proceeding with the next six letters the beginner should practise himself with the first 12 letters (lessons 1 and 2 combined). No new series of letters should be undertaken until it is found that the whole of the preceding letters have been cemented in the mind.

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Learning letters in pairs where each pair is the opposite in Morse composition one of the other is not recommended. Thus, to learn that **A** (· —) and **N** (— ·) are opposites often produces the after effect of making the beginner confuse one for the other. This method of committing the Morse Alphabet to memory finds frequent expression in those somewhat extensively advertised lines :—

Every **Time**
(·) (—)
I **Make**
(· ·) (— —)
Signals **On**
(· · ·) (— — —)
High
(· · · ·)
&c. &c. &c.

For practising flashing, each letter should be made at the standard rate ultimately aimed at. If the reader is a beginner he should be allowed an ample pause (as long as he likes) between the different letters, in order to allow him plenty of time to piece the elements together in his mind, and so recognise the letter the entire symbol stands for. By this means the beginner, from the very commencement, learns to recognise the letter by how it appears in its entirety, rather than by having to build up the component parts in his mind. The principle of learning, therefore, should be to make each letter at the standard rate ultimately aimed at, but, at the same time, to allow a pause (to be gradually shortened as the beginner gains proficiency) between each letter.

In the schools of Naval Signalling it has been found best for beginners to be taught to read groups of letters (which do not spell sense) correctly before allowing them to read words making sense. If the beginner commences his flashing education by trying to read sense he is apt to get into the habit of guessing what a word is likely to be before it is actually completed. Such anticipation is a fruitful source of mistake, and should be carefully guarded against.

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A very good form of exercise is to mix three alphabets together in any order into groups of five letters, as is shown in the Example given below :—

Q U I F D
M L Y J G
P C N I A
M U B Q K
K J A V I
Q G M U O
R T V X P
C E Y R H
E G J E S
F N W H Z
A N T P H
R B B Y X
D O W K D
L F Z W S
O Z L C X
S T V

The above is commonly called a *Test* Message and has the advantage of being a convenient standard to test a person's degree of accuracy in reading flashing at any given rate. It is based on the following principles. It has been found that the average length of English words used in ordinary prose is practically equivalent to five letters. It is also found that the number of Morse units it takes to send an ordinary message of twenty words average about 930, which is approximately equal to the number of units expended in the above Test Message. But it will be observed that a Test Message only consists of 78 (three alphabets) which—as the average word consists of five letters—falls short of 100 letters by 22 and only consists of 15·6 groups. This apparent discrepancy is explained by the fact that in the Test Message letter **Q**, for instance (which is 13 units in length), appears the same number of times (three) as **E** (which is but one unit in length), whereas in ordinary prose the shorter symbol for **E** (·) would recur about 140 times to every time that **Q** did once.

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When it is desired to test any person's proficiency at a given rate, the time allowed for sending the Test Message may be arrived at by dividing 20 by the rate number. Thus, a Test Message at six words per minute, or rate 6, should take 3 minutes and 20 seconds.

FLASHING LAMPS.

Flashing Lamps are of two different classes—those which are flashed by mechanical means, and those which are controlled electrically. The former are worked by opening or closing an aperture in front of the light by means of a hand-worked shutter or disc. The latter are manipulated by a Morse key which makes and breaks the circuit.

The following is a list of some of the various lamps supplied for making flashing signals :—

Name of Lamp.	Description of Lamp.	Method of Flashing.
Searchlight – –	Electric Arc – – –	Detachable Scott's Shutter.
Cruiser Arc – –	Electric Arc, 2,000 C.P. –	Venetian Blind.
Truck Flashing Lamp	16 Six C.P. Electric Lamps	Morse Key.
Yardarm Flashing Lamp.	8 Six C.P. Electric Lamps–	Morse Key.
Oil Flashing Lamp –	Burner and Wick for using Mineral Sperm Oil.	ShutterandSpring.
Boat's Flashing Lamp	Candle – – – –	Disc and Spring.
Naval Examination Service Lamp.	Acetylene – – –	Morse Key.

The Multiple Fibre flashing lantern is so called because it contains a cluster of 16 separate incandescent electric lamps, each containing a single carbon fibre of the thinnest practical make.

This lantern, which has an aggregate candle power of 96, is designed for use at the truck, a position remote from other distracting lights, where signals can be seen from every point of the compass free from the obstructions offered by the masts, funnels, smoke, and upper works of a ship.

The lamp filaments are specially made so that, when the circuit is completed or broken by a make-and-break

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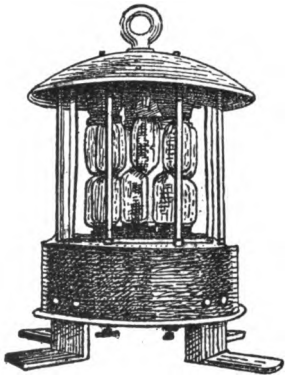
key on deck, they reach full incandescence or get black cold in the shortest possible time.

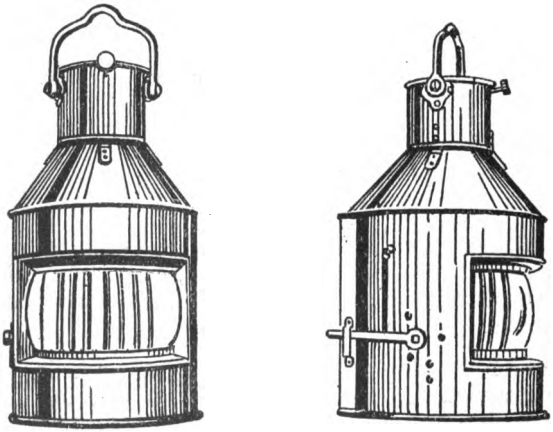


Multiple Fibre Masthead Flashing Lantern.

Oil Flashing Lanterns.

As a provision against the dynamo not being available, or an electrical breakdown, ships are also provided with an oil flashing lantern.

This lantern shows an arc of visibility of 120°. Up to recently it burnt rapeseed oil, the flashes being made by means of a Scott's shutter, the effective candle power being about 10.



Oil Flashing Lantern fitted with Scott's Shutter.

A newer pattern of lantern to supplant the above will burn mineral oil, and will give considerably greater candle power with an improved flashing device.

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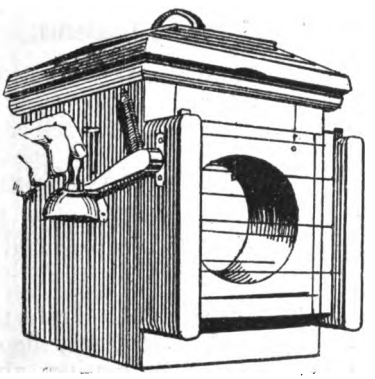
Everett's Cruiser Arc Lamp.

As a rough rule it is estimated that a 100-candle power flashing light can be read with moderate ease at a distance of 5 miles on a dark night with a clear atmosphere. Consequently, to provide for, say, 10 miles, it would be necessary to use a light of 400-candle power, as the intensity of a light varies inversely with the square of the distance. So, in order to be able to signal at horizon distances (which may be reckoned as 15 miles between large ships), a light of about 900-candle power would be required. As it would be inconvenient to obtain this power by incandescent fibres, the arc lamp is made use of. These arc lamps burn 10 ampères of current, are hand fed, and are fitted in wooden lanterns.

The arc of visibility is designedly limited, and the flashes are made by a Venetian blind, which can be opened and closed by means of a side lever key.



Cruiser Arc Flashing Lantern (showing Venetian Blind open).

The candle power is sufficient for signalling over distances of from 12 to 15 miles on a dark night with clear atmosphere.

Boat's Flashing Lantern.

For use in boats a small candle lamp is used. The flashes are made by means of a moveable screen inside

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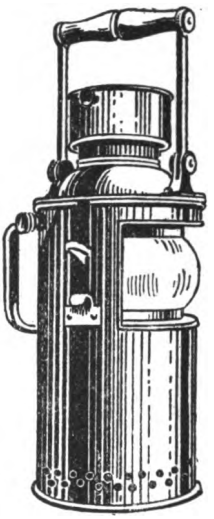
the lantern, which can be raised or lowered by a side lever key.



Acetylene Flashing Lanterns.

The more important shore signal stations are provided with powerful acetylene lanterns.

SEARCHLIGHT SIGNALLING.

For signalling over maximum distances, both by day and by night, ship's searchlights are provided with Scott's shutters.

By this means it is possible to flash this powerful light directly to a ship at distances only dependent upon the heights of the sender and the receiver above the sea. But even supposing the horizon intervenes, signalling by the searchlight at night is still possible by virtue of the visibility of the beam from below the horizon, or its reflection on a suitably shaped intermediate cloud.

For direct flashing it is essential that the searchlight be trained accurately on to the receiving ship or station. The arc of dispersion of the light is from 3° to 6°, according to the size of the carbon used, but a greater dispersion can be obtained by adjusting the carbons forward out of focus. To facilitate keeping the training on, a telescope is used. It is fitted to the projector so that its line of collimation

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is parallel to the axis of the barrel. The distant ship is kept in the field of the telescope by aid of a shoulder piece. One man keeps the sights on while another works the shutter.

BOATS' SIGNALS.

How to look out or make a Signal from Boats' Signal Book.

(*a*) *How to look out :—*

Signals made from the Boats' Signal Book are made by Numeral Flags.

(i) Two flag signals.
(ii) Three flag signals.
(iii) Four flag signals.

(i) These signals (00–99) are General Service Signals.

(ii) 100–649 are various, such as :—
Action, Anchors and Cables, Sailing, Torpedo, &c.

(iii) These signals 1000 to 3299 are tables, such as :—
Geographical Table, List of Navy, &c.

It is therefore very easy, on a signal being made, to turn to the correct page, as the signals run in sequence from top to bottom on the left-hand side of the page, with the signification against them. In the four flag signals there are two columns on each page.

(*b*) *How to make a signal :—*

Do not endeavour to make a signal by turning over the pages in the hope of coming across the Signification, but immediately turn to the Index, which is provided for that purpose ; then turn to the page to see if it is the Signification you require before making the signal. The signal to make is on the left of the Signification.

Boats' Distinguishing Signals.

1. " B " Flag is the distinguishing signal for " All Boats " and is the General Recall for Boats.

Signals made by the Senior Officer inferior to " B " Flag are addressed to all boats and are to be repeated by all ships present.

" B " Flag superior to Church Pendant hoisted by Senior Officer addresses " All Steam Boats."

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"B" Flag superior to Numeral Pendant hoisted by Senior Officer addresses "All Boats under Sail."

Signals made inferior to these Distinguishing Signals are also to be repeated by all ships present.

"B" Flag superior to Guard Pendant will address the Guard Boat.

2. A Pendant or Pendants hoisted inferior to "B" Flag by any ship will address the boat or boats belonging to that ship, specified by the Pendant or Pendants.

3. A ship's Pendants hoisted superior to any distinguishing signal for boats will address the boat or boats specified belonging to that particular ship.

4. During General Exercise, Boats Exercise, &c., and at any time when there is any possibility of confusion arising, ships are to hoist their Pendants superior to Boats' Signals or Recalls.

5. A Boat's Distinguishing Signal hoisted singly is the Recall for the boat or boats specified, and is to be obeyed as soon as seen, unless orders have been given to the contrary.

6. In each ship the boats, as far as practicable, are numbered as in the following series, and the pendant representing such number or sign will, when hoisted inferior to Flag "B," form their distinguishing signal:—

1st Picket Boat	–	–	0 Pendant.
2nd ,, ,,	–	–	1 ,,
Steam Pinnace	–	–	2 ,,
Launch –	–	–	3 ,,
Sailing Pinnace	–	–	4 ,,
1st Cutter –	–	–	5 ,,
2nd ,, –	–	–	6 ,,
3rd ,, –	–	–	7 ,,
Galley –	–	–	8 ,,
1st Gig –	–	–	9 ,,
Whaler –	–	–	Blue Pendant.

7. Ships having more than the above number of boats arrange to use the Interrogative, Answering Compass and Guard pendants.

8. Ships having less than the above number of boats arrange their Distinguishing Signals so that the particular boats mentioned in the above table have the Distinguishing Pendants enumerated.

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9. By night boats will be addressed by the letter "B" preceding the Pendant Sign and number or sign of the Boat's Distinguishing Pendant.

Example:—2nd PICKET BOAT—(see table above).

B Pendant 1

When necessary, ships' Pendants should precede Boats' Distinguishing Signals in addressing.

Distinctive Flags in Boats.

(i) Flag Officers in boats when on duty fly the flag of their respective rank in the bows.

(ii) All Captains, Officers in Command of H.M. Ships, and the Officer of the Guard in boats when on duty fly a pendant in the bows.

(iii) Any boat flying a flag or pendant in the bows proceeding alongside a foreign ship should have an ensign flying in addition.

(iv) When any Governor, civil or military, or Consular Authority for whom a special distinguishing flag is provided by the King's Regulations embarks in a boat of any of H.M. Ships, such flag is to be displayed from the bow of the boat, and this boat shall fly her ensign in addition.

(v) The Union Jack is never to be displayed from any of the boats of H.M. ships, except for the purpose of denoting the presence of an Admiral of the Fleet.

(vi) When ships are dressed in Home Waters, Boats away from their ships are to fly their ensigns. (As Torpedo Craft are not supplied with boats' ensigns this does not apply to those vessels.)

Salutes in Boats.

(i) Laden boats, or those towing or in tow, are not included in the Table of Salutes. The officer or coxswain will only salute.

(ii) Coxswains of boats, when an officer is in charge, do not salute except at landing-places, and then only when ordered to do so, by the rules in the Table of Salutes.

(iii) Men in dingies, skiffs, shore-boats, &c., are to salute by laying on their oars. Sitters saluting but not standing up in the boat.

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(iv) Officers of branches other than the Military Branch are to receive the same salutes as officers of the Military Branch of corresponding rank with the exception of tossing or laying on oars, and letting fly sheet.

(v) In the case of boats conveying officers of branches other than the Military Branch passing, or being passed by, boats conveying officers of the Military Branch of the same relative rank, the officers in charge of the boats, or the coxswains, should there be no officers in charge, are to mutually salute.

(vi) Boat-keepers are to stand up and salute officers who pass their boats, unless the boat's awning is spread, when they will sit up smartly and salute.

(vii) The Officer of the Guard with his pendant flying is to be saluted by all officers of junior rank, as in the case of a Captain with his pendant flying. The Officer of the Guard will salute all officers senior to himself as laid down in the Table of Salutes.

(viii) When passing a funeral party afloat with the body, oars will be tossed by double-banked boats or corresponding marks of respect by either pulling or steam boats.

(ix) When the colours are being hoisted in the morning or being hauled down at sunset, all boats under way should stop engines, toss oars, or let fly sheets; Officer or Coxswain saluting, until the colours are hoisted or hauled down as the case may be.

(x) Boats fly ensigns when :—

(1) Ships are dressed.

(2) Going to a Foreign man-of-war.

(3) In a Foreign Port.

NOTE.—In boats fitted with crutches, oars are never to be tossed, but the salute given by laying on oars.

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TABLE OF SALUTES.

The following rules for marks of respect between officers of different ranks in boats are to be observed.

Rank of Officer in Boat.	When Passing.	Under Oars.	Under Sail.	In a Steamboat.	Meeting at Landing-place.		
					*Single-banked Pulling Boat.	*Double-banked Pulling Boat.	†Steamboat.
Captain or Commander.	Flag Officer.	Lay on oars, officer salutes.	Let fly sheet, officer salutes.	Ease engines, officer salutes.	Crew to attention, officer salutes.	Crew to attention, officer or coxswain salutes.	Crew stand up by order, officer salutes.
All other officers and coxswains with no officer in boat.	Do.	Toss oars, officer or coxswain salutes.	Let fly sheet, officer or coxswain salutes.	Stop engines, officer or coxswain salutes.	Crew to attention, officer or coxswain salutes.	Crew stand up by order, officer or coxswain salutes.	Crew stand up by order, officer or coxswain salutes.
Commander.	Captain.	Officer salutes in all cases.					
Lieutenant-Commander or Lieutenant and all junior officers and coxswains with no officer in boat.	Do.	Lay on oars, officer or coxswains salutes. Toss oars if pendant is flying.	Let fly sheet, officer or coxswain salutes.	Ease engines, officer or coxswain salutes. Stop engines if pendant is flying.	Crew to attention, officer or coxswain salutes.	Crew to attention, officer or coxswains salutes. Crew stand up by order if pendant is flying.	Crew stand up by order, officer or coxswain salutes.
Lieutenant-Commander or Lieutenant.	Commander.	Officer salutes in all cases.					
All officers junior to Lieutenants and coxswains with no officer in boat.	Do.	Lay on oars, officer or coxswain salutes.	Let fly sheet, officer or coxswain salutes.	Ease engines, officer or coxswain salutes.	Crew to attention, officer or coxswain salutes.	Crew to attention, officer or coxswain salutes.	Crew stand up by order, officer or coxswain salutes.
Do.	Lieutenant-Commander or Lieutenant.	Officer or coxswain salutes in all cases.					
Coxswain with no officer in boat.	All officers junior to Lieutenant.	Coxswain salutes in all cases.					

* "Crew to attention" means sitting square on thwart facing aft. The order "Boat's Crew" is to be used for this purpose.
† When crew stand up they are to face in the direction of the officer they are saluting.

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REPLY WHEN HAILED AT NIGHT.

Boats going alongside conveying any Royal Personage, reply – –	**STANDARD.**
Lords of the Admiralty – –	**ADMIRALTY.**
Boats going alongside conveying— Admiral, reply – – –	**FLAG,** WITH NAME OF SHIP TO WHICH THEY BELONG.
Captains and officers in command –	NAME OF SHIP THEY COMMAND.
Officers of Wardroom rank –	**AYE, AYE.**
Officers below that rank, and all boats going alongside – –	**NO, NO.**
Officers of the Guard – –	**GUARD BOAT.**
All boats passing, but not calling alongside – – – –	**PASSING.**

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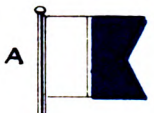
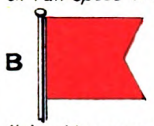
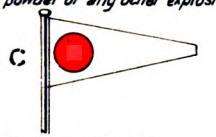
FLAGS AND PENDANTS USED IN THE INTERNATIONAL CODE.



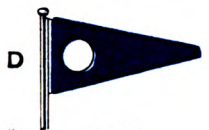
Flown by Man-of-War when on Full Speed Trial.



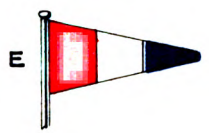
Hoisted by a vessel when taking in or discharging gunpowder or any other explosive.

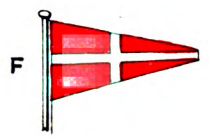


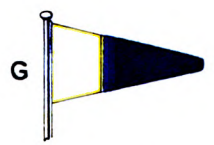
"Yes" or affirmative.

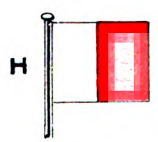


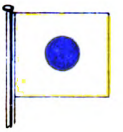
"No" or negative.

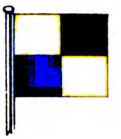


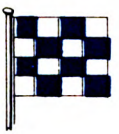


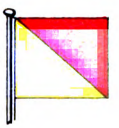




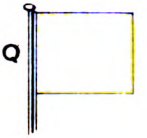


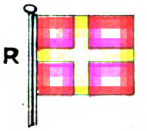


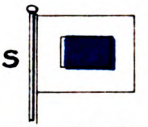




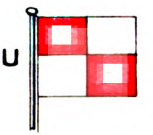
Signal for all persons to repair on board, as the vessel hoisting it is about to proceed to sea.

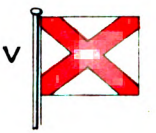


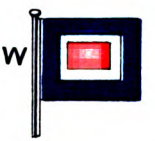


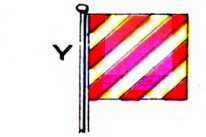


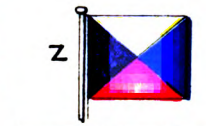
International Pilot Signal "I require a Pilot."



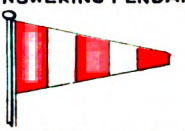








"Code Flag" and "Answering Pendant."



When hoisted under the Ensign it denotes a signal taken from the International Code. When hoisted by itself at the mast head or where best seen, it is the Answering Pendant.

The Red Ensign.

hoisted at the Mast-head of a British Man-of-War, indicates that she wishes to communicate with a British Merchant Vessel, or that she is taking in a signal which is being made by a British Merchant Vessel.

A Man-of-War when taking in a signal, will in addition to the above, answer the signal in the usual way with the Code Flag.

1880.

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INTERNATIONAL CODE.

These flags (*see* plates) are used with the International Code Book for communicating with ships belonging to all nations, the characteristic of this code being the Code Flag, which is used inferior to the ensign. Signals are also answered with this flag.

The British Signal Manual.

For communicating between H.M. ships and British merchant vessels, the British Signal Manual has been compiled.

By day the characteristic of this book is the Red Ensign, signals being answered with the Code Flag.

By night the " British Signal Manual sign "—

(▬ • • ▬ • • ▬ • • ▬ • • ▬ • • &c.,)

is used for addressing one another, and answered by—

(• ▬ ▬ • ▬ ▬ • ▬ ▬ • ▬ ▬ &c.,)

the " answering sign."

International Salutes.

1. The Captain of a ship or the Senior Officer of more than one ship, on anchoring at a foreign port where there is a fort or battery, or where a man-of-war of the nation may be lying, shall salute the National Flag with 21 guns on being satisfied that the salute will be returned.

2. If one or more British ships of war meet a foreign ship of war bearing the flag of a Flag Officer senior in rank to the Senior Officer in command of H.M. ship or ships, such Senior Officer shall salute the Foreign Flag Officer with the number of guns as laid down if in port after the proper national salutes shall have been interchanged.

3. A list of saluting stations is supplied to each ship.

4. The following regulations, in which the Maritime Powers generally have concurred, are observed in reference to the interchange of salutes between H.M. ships and foreign ships of war which bear the flag of a Flag Officer or the broad pendant of a Commodore, or a Captain commanding a squadron or division :—

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	Guns.
The flag of an Admiral of the Fleet or Flag Officer who ranks with a Field Marshal is to be saluted with	19
The flag of an Admiral	17
The flag of a Vice-Admiral	15
The flag of a Rear-Admiral	13
The broad pendant of a Commodore or a Capitaine de Vaisseau Chef. de Division in the French Navy	11

As the rank of a Full Admiral does not exist in the French Navy, Vice-Admirals of that nation whose flags may be hoisted at the main are to be regarded as Full Admirals, and are to be saluted with 17 guns.

5. Salutes to be returned :—

The following regulations are observed in regard to return salutes to and from H.M. ships and forts or batteries :—

(*a*) All salutes from foreign ships of war, either to H.M. ships or forts, are to be returned, gun for gun. Should there be no fort or battery from which such salutes can be returned, the Senior Naval Officer present will return them gun for gun.

(*b*) Salutes to the National Flag, on anchoring at a foreign port, are returned gun for gun.

(*c*) Salutes to the flags of foreign Admirals and Commodores, when met with at sea, or in harbour, are returned gun for gun.

6. Salutes not to be returned :—

(*a*) Royal salutes.

(*b*) To H.M. subjects (except salutes to superior naval authorities).

(*c*) To Royal personages, Chiefs of States, or members of Royal Families, whether on arrival at, or departure from, a port, or upon visiting ships of war.

(*d*) To diplomatic, naval, military, or consular authorities, or to governors or officers administering a government, whether on arrival at, or departure from, a port, or when visiting ships of war.

(*e*) To foreigners of high distinction on visiting ships of war.

(*f*) Upon occasions of national festivals or anniversaries.

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To face p. 58

ENSIGNS. (MAN OF WAR AND MERCHANT.)

ADMIRAL'S FLAGS ETC.

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	Man of War	Merchant	Admiral
AUSTRIA			
BELGIUM			Also Lieut-Admiral.
DENMARK			
FRANCE			NONE
GERMANY			

1880

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GREECE

Man of War

Merchant

Admiral

HOLLAND

ITALY

NORWAY

PORTUGAL

V.A. Cinc.

1880

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GREECE

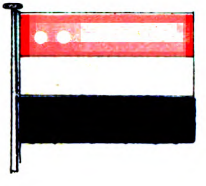
Vice

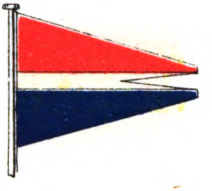
Rear

Commodore

Captain Comdᵍ a Division

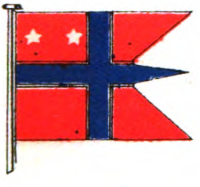
HOLLAND

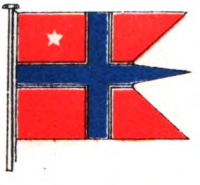


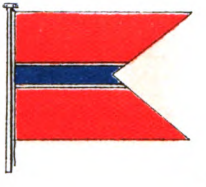


ITALY

NORWAY

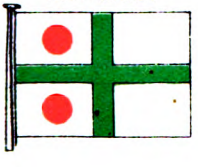




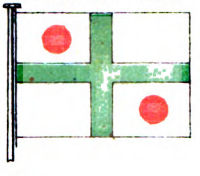


PORTUGAL

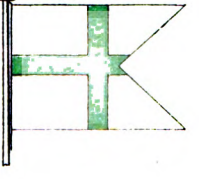
R.A. Cinc.



R.A. not Cinc.



Captain Comdᵍ a Division.



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RUSSIA

Man of War

Merchant

Admiral

SPAIN

SWEDEN

TURKEY

BALKAN STATES

Man of War

Merchant

Man of War

ROUMANIA

BULGARIA

1880

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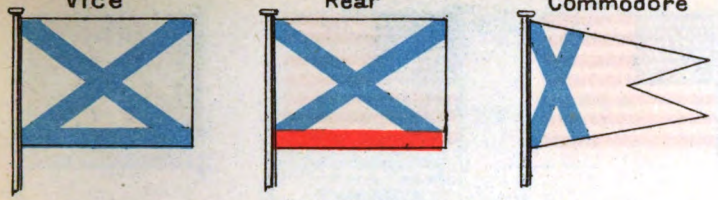
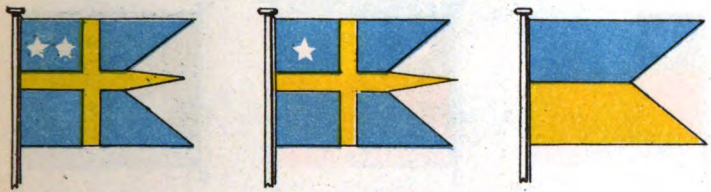
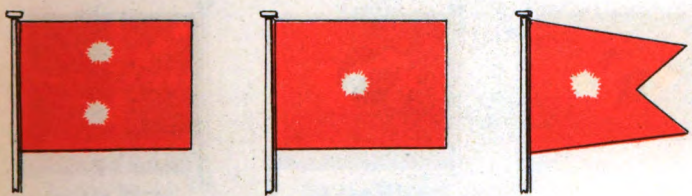


RUSSIA

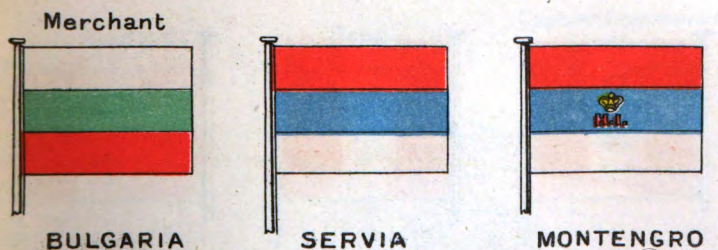
SPAIN



SWEDEN



TURKEY



BALKAN STATES

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	Man of War	Merchant	Admiral
UNITED STATES			
ARGENTINE			
CHILI			Vice
BRAZIL			Admiral (at the Main)
PERU			

1880

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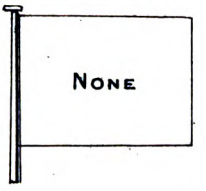
Vice

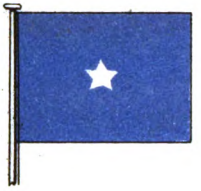
Rear

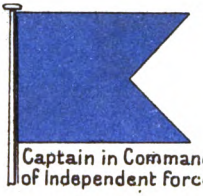
2nd in Rank Red with White Stars
3rd in Rank White with Blue Stars



Commodore

UNITE

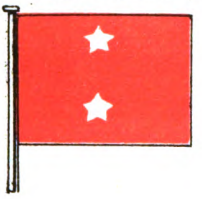




Captain in Command of Independent force

ARG

Rear



R.r Adl. 2nd in Command

Commodore

(if not independent, white Star on Red Field)

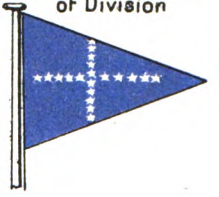
CH

Vice

(at the Fore)

Rear

(at the Mizen)

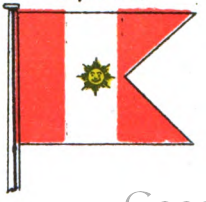


Capt.n in Command of Division

BR

Vice

Rear



Captain Commanding Squadron.

PER

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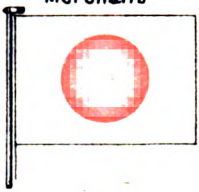
JAPAN

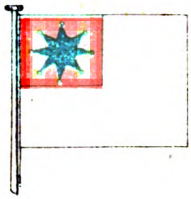
Man of War

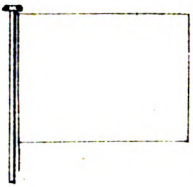
Merchant



Admiral

CHINA





Man of War

Merchant

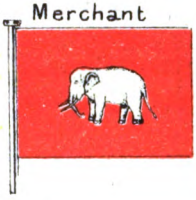
MEXICO

Man of War

SALVADOR

Man of War

Merchant



SIAM

VENEZUELA

ECUADOR

GUATEMALA

PARAGUAY

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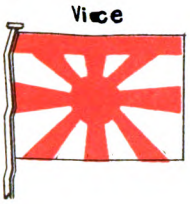
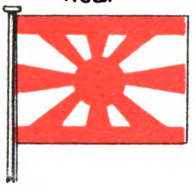
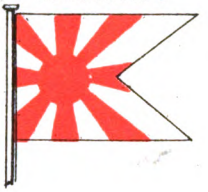
1880



Vice

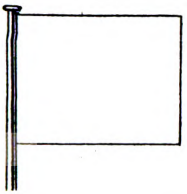


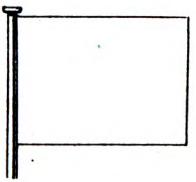
Rear

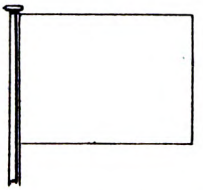


Commodore

JAPAN

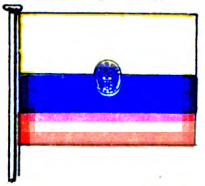






CHINA

Merchant

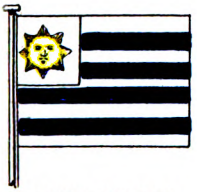


Man of War

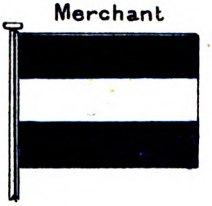
Merchant

SALVADOR

COLUMBIA



Man of War



Merchant

URUGUAY

HONDURAS

DOMINICAN REPUBLIC

HAYTI

NICARAGUA

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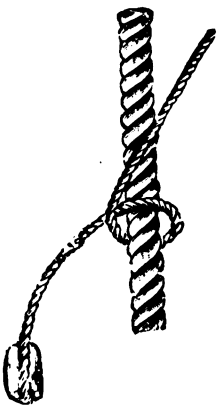
CHAPTER III.

BENDS AND HITCHES.

Half Hitch.

Used generally, and often in conjunction with other hitches. Its formation is easily seen from diagram.



Timber Hitch.

For securing the end of a rope to a spar, also for bending a rope round light cases, bales, &c., when provisioning ships, formed by making a half hitch with

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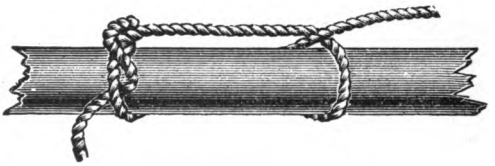
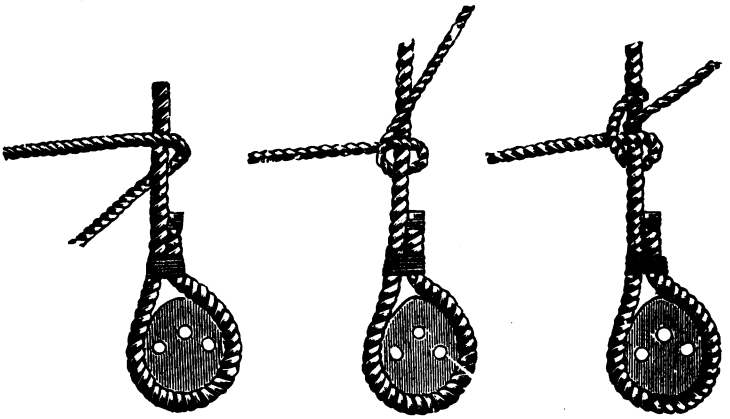
rather a long end and expanding the end backwards round its own part. Used also with a half hitch for towing spars.



Clove Hitch.

Is really a jambing form of two half hitches, and is generally used when a small rope has to be secured to a larger one and the end still kept free to use for further purposes, as in securing ratlines to the shrouds, and used also for securing the end of butt slings. Its formation is shown in the following diagrams.



Rolling Hitch.

Is commenced and finished like a clove hitch, but as can be seen from the figures, there is an intermediate round turn between the first and last hitches. It will be seen that the round turn in Fig. 2 is taken round both the standing part (*a*) and the larger rope. The great value

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of this hitch is that it does not slip, and this can be rendered doubly sure by backing the end (*c*) round the part (*d*) and securing the end with a stop. Used for bending a small rope to a larger one; putting a tail jigger on a rope; securing hammocks to the gantlines.

Fig. 1.

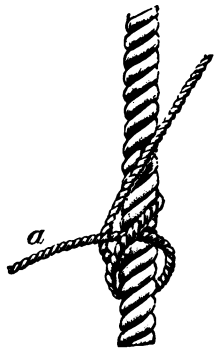

Fig. 2.

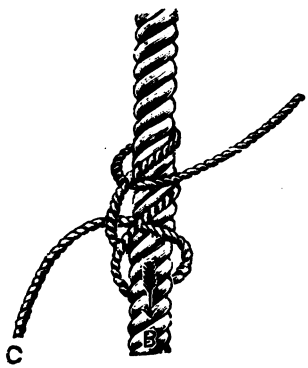

Fig. 3.

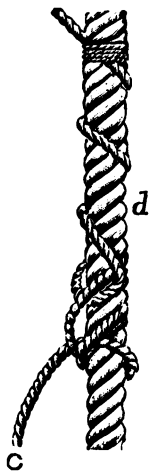

Fig. 4.

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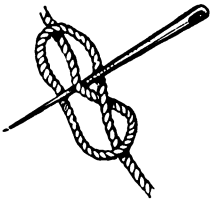
Round Turn and Two Half Hitches.

For securing a hawser to the ring of a buoy. In this case the rope should be parcelled.

A Round Turn and Two Half Hitches.

Marline Spike Hitch.

Is used for heaving the turns of a seizing taut with a marline spike, or hooking the hook of tackle to any rope where a small pull is required. It is preferable to a catspaw (*see* page 80), as it never jambs; formed by the standing part picked through a loop laid over it, so that the spike lays under the standing part and over the sides of the loop.



Marline Spike Hitch.

Blackwall Hitch.

Consists of a half hitch, as soon as any strain comes on it the standing part (*a*) jambs the end part (*c*). By taking another round turn at (*b*) before passing (*c*) under (*a*) it will hold more securely. Used for hooking a tackle to a rope

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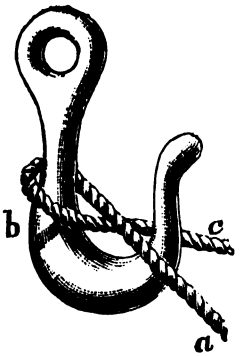
and bringing the fall of one jigger to the double block of another.



Double Blackwall Hitch.

Is made by taking the bight of the rope and placing it across the neck of the strop of the block, crossing it behind, then placing the under part over the hook and crossing the upper part on top of it. It holds better than either of the two preceding hitches, and is used for the same purpose.

Marling Hitch.

For lashing up hammocks, or putting a temporary seizing on two ropes or spars; also used when making swabs.

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Midshipman's Hitch.

Is sometimes used instead of a Blackwall hitch, and will hold better if the rope is at all greasy. It is made by first forming a Blackwall hitch and then taking the underneath part and placing it over the bill of the hook.

Fisherman's Bend.

Is formed by taking two round turns around the object to which the rope is to be secured, and then backing the end round in the form of a half hitch under both the standing part and second round turn. The end may be further secured by taking a half hitch around its own part or by stopping it to it (Figs. 1, 2), the dotted line showing the next direction the end *c* must take. Used for bending a hawser to the ring of an anchor, or a rope's end to a bucket.

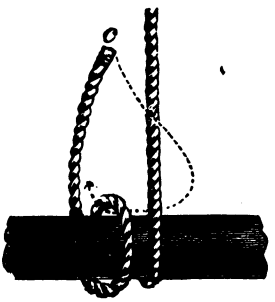

Fig. 1.

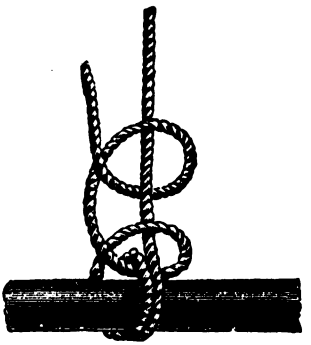

Fig. 2.

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Carrick Bend.

For bending two hawsers together when required to go round a capstan.

First form with hawser No. 1 a loop as in Fig. 1.

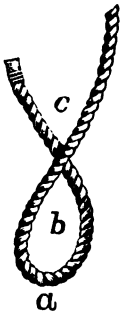

Fig. 1.

Pass the second hawser under the first at *a*, bring up through the eye *b*, back it over the cross at *c*, and bring up again towards you through the eye *b*, and then stop the ends of each hawser to their own respective parts (Fig. 2).

Fig. 2.

Reef Knot.

The simplest of all knots, and is always used when a common tie is required. Its formation may be easily traced in Figs. 1 and 2. Having constructed the knot as far as

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Fig. 1, be sure part *a* is kept in front of part *b*, as here shown, and the end *c* led in according to the direction of the dotted line.

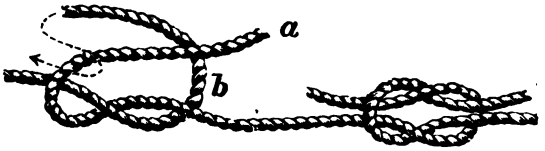

Fig. 1. Fig. 2.

Sheet Bend.

In making a bend the ends of the two ropes are not used simultaneously as in forming a reef knot, but an eye or loop is first formed in the end of one of the ropes, as in Fig. 1, and the other rope's end is then rove through it in various ways according to the bend desired. Used for securing boat's lazy painters to the Jacob's ladders of the Lower Booms.

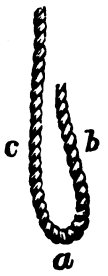

Fig. 1.

To form a Sheet Bend, pass the second rope's end underneath the eye at point *a* and bring up through the loop, then form with it a half hitch round *c* and *b* (Fig. 2).

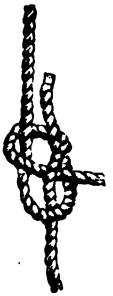

Fig. 2.

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It will hold still better, and is less likely to jamb, if the end is passed round again as in Fig. 3. This is called a Double Sheet Bend.

Fig. 3.

Bowline.

First take part *z* in the right hand with *y* in the left hand, place *z* on *y*, and, turning the left hand over from you and to the left, form a loop and reeve *c* as shown by the dotted line and haul taut. Used for slinging a man over the ship's side; bending two hawsers together.

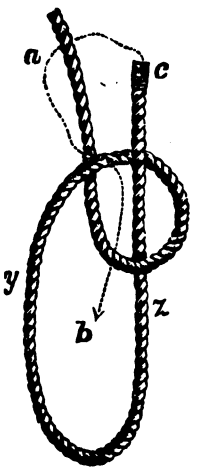

Fig. 1.

Fig. 2.

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A Running Bowline.

Form a loop with a long end *c* lying underneath the standing part *a* (Fig. 1).

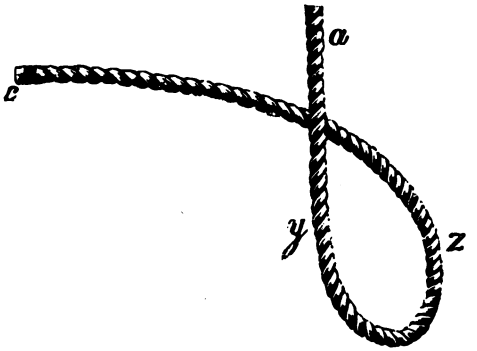

Fig. 1.

Now bring end *c* over part *y* and with it form the bowline knot on part *z* just as in the previous case we formed it on its own part, when it will appear as in Fig. 2. It is used whenever a running noose is required.

Fig. 2.

A Bowline on the Bight.

Using both parts of the rope together, commence as in making an ordinary bowline. To finish off, open out bight *c*, and taking it in the direction indicated by the dotted line, pass the whole knot through it and haul taut, when

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it will appear as in Fig. 2. Used for lowering a man from aloft, or slinging a man over the ship's side.

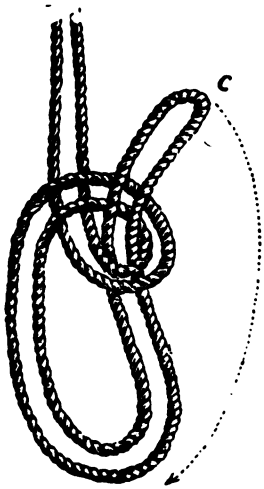

Fig. 1.

Fig. 2.

Figure of Eight Knot.

Back *c* round behind *a*, bring over part *z* and dip down through bight *b* and haul taut. Is put in the end of a rope to prevent it unreeving.

Overhand Knot.

Is often used for the same purpose.

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A Sheep Shank.

Is used for shortening a rope which requires lengthening again. Gather up the amount desired in the form of Fig. 1.

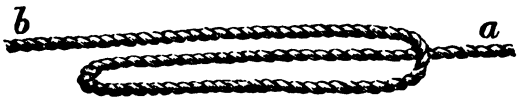

Fig. 1.

Then with parts *a* and *b* form a half hitch round the two parts of the bight as in Fig. 2.

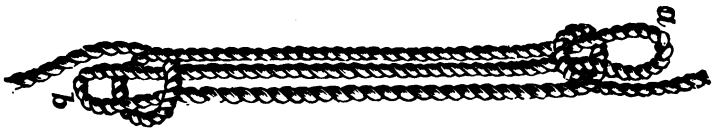

Fig. 2.

To render it still more dependable, the bights *a* and *b* may be seized or toggled to the standing parts as in Figs. 3 and 4.

Fig. 3.

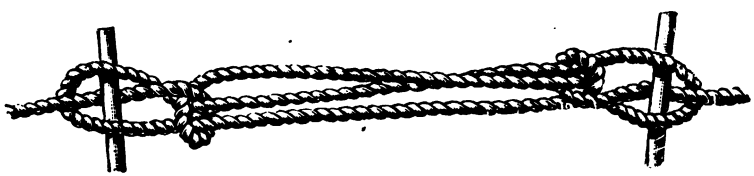

Fig. 4.

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A Catspaw.

Is formed in a rope to make a temporary loop for hooking on the block of a tackle or shortening up a bale sling strop. First throw back a bight as in Fig. 1.

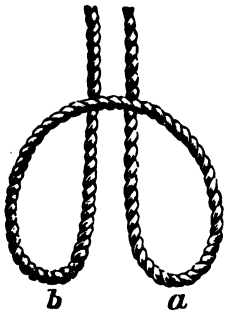


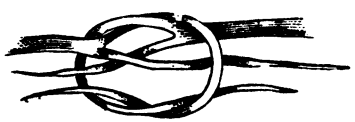
Fig. 1.

Then, taking hold of *a* and *b* in either hand, twist them up as in Fig. 2; bring together the two eyes *a* and *b*, and hook in the tackle.

Fig. 2.

Rope Yarn Knot.

For joining two yarns together.



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Hawsers are bent together by two half hitches and seizing the ends, in addition to the methods previously mentioned.

A hook is moused to prevent it becoming unhooked.

A stopper is used for securing a rope whilst it is being belayed.

Bend Hawsers.

Mouse a Hook.

To pass a Stopper.

Take the stopper in the left hand, make a half hitch against the lay, dog the end with the lay of the rope, and seize it. With left-handed rope end of stopper should be passed under the rope from left to right.

To pass a Stopper.

To put a Strop on a Hemp Rope.

Centre the bight of the strop and place it over the rope, then dog the ends opposite ways under and over, and hook on the tackle to both bights.

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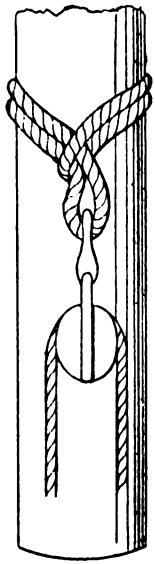
To put a Strop on a Spar.

Use the ordinary bale sling strop.



Put a Strop on a Spar.

A Parbuckle.

Is used for hauling up or lowering down a cask, or any cylindrical object where there is no crane or tackle. Middle the rope to be used for the parbuckle, place the bight over a post or pin as most convenient; the two ends are then passed under the two quarters of the cask, bring the ends back again over it, and they being both hauled taut or slackened together, either raise or lower the cask as may be required. Care must be taken to keep an equal strain on both parts to prevent the cask slipping out.

Parbuckle.

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To put on a Tail Jigger.

Take the first two parts of a rolling hitch, dog the end with the lay and seize it. (Similar to passing a stopper but with an additional turn.)

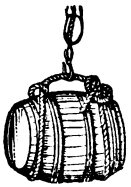
Tail Jigger.

To Sling Casks.

There are several methods of slinging a cask, viz., with butt slings, bale slings, and head up, also by means of can hooks.

A Butt sling is a single piece of rope fitted with an eye splice in one end, and the other end pointed or whipped.

To sling the cask, the cask is placed on its bilge bung up; reeve the end of the sling through the eye splice and place the loop thus formed over one end of the cask between the first and second hoops, and haul it well taut, the eye splice being in line with the bungs; then take the end of the sling round the other end of the cask between the first and second hoops, and clove-hitch it to its own part in line with the bung.



Butt Slings.

A Bale sling is a single piece of rope short-spliced together.

To sling a cask, the cask is placed on its bilge bung up, the slings passed underneath both ends of the cask between

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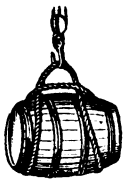
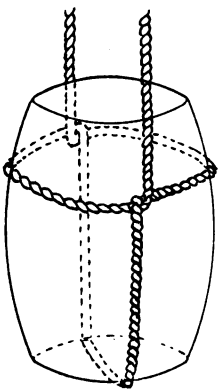
the first and second hoops; the bights are then taken over the cask, and one bight passed through the other, taking care the cross is in line with the bung.



Bale Slings.

To sling a cask head up, the cask is placed on its end, pass a rope's end under the bottom fairly in the centre, then form an overhand knot with both ends of the rope on top of the cask, open the knot out, and place the bights over the head between the first and second hoops, haul them well taut, then reef-knot both ends together on top. This method is only used when the head of the cask is missing or damaged.



Sling a Cask on end.

A grating is slung by passing the bight of the rope under the ends of the grating and clove-hitching them round the grating at each corner.

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Can Hooks.

Are used for breaking out a cask, *i.e.*, for lifting out the first cask of a tier where there is not room to put on a butt or bale sling. Casks are never hoisted right up with can hooks.

Can Hooks.

To pass a Life-line.

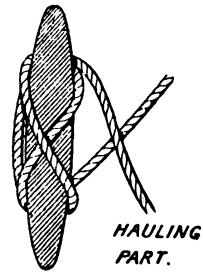
Dip the end under the slings and over the davit head twice, and take two or three turns round all parts and hold on to the end.

To pass a life-line for a "full due," proceed as above, but substitute half-hitches for round turns, and tuck the end in.

To secure a Rope round a Cleat.

First take a round turn, then a figure of eight knot is made round the cleat or pin, and repeated at least twice; on no account should a half hitch be made over the pin or cleat afterwards. The main object is to ensure that the rope will not jamb.

To secure a Rope round a Belaying Pin.



To secure a Rope round a Cleat.

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KNOTS AND SPLICES, &c.

Wall Knot.

Is used for finishing off seizings, forming a shroud knot; is also used on the end of a rope to prevent it unreeving.

To form a Wall Knot.—First unlay the rope so that the strands appear as in Fig. 1.

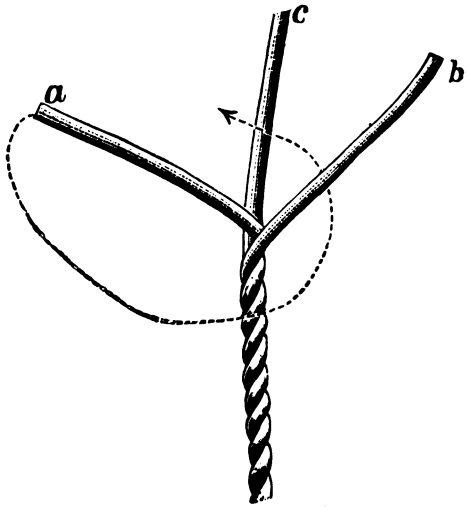

Fig. 1.

Holding the rope with the left hand, with the right lead strand *a* in the direction indicated, viz., under strand *b* and up between strands *b* and *c* (Fig. 2).

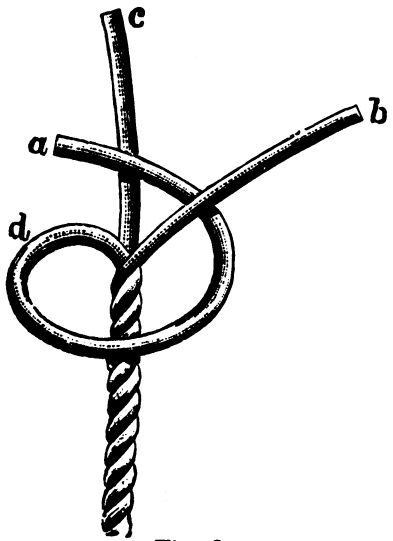

Fig. 2.

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Then with strand *b* form a similar loop, enclosing strands *a* and *c*, and bringing the end of strand *b* up between *a* and *d* (Fig. 3).

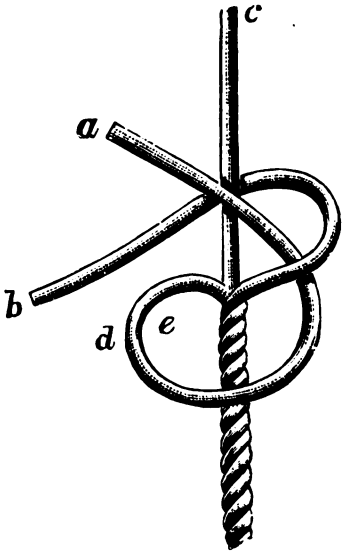

Fig. 3.

Now with strand *c* form a similar loop, enclosing strands *b* and *a* by leading the end of strand *c* up through the loop *e* in strand *a* (Fig. 4).

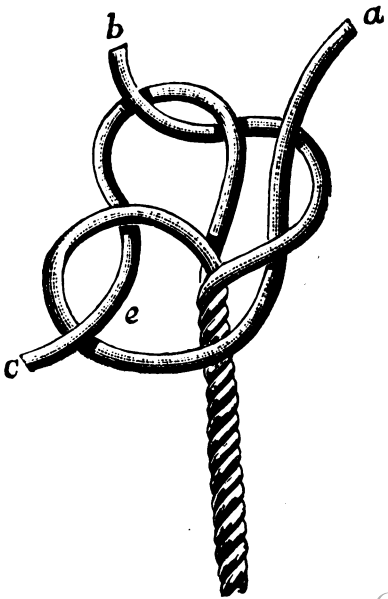

Fig. 4.

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Finally, work all parts well taut, whip the ends of the strands together, and cut off short (Fig. 5).

Fig. 5.

A Double Wall Knot is formed by allowing each strand to again follow its lead as given in a single wall knot, opening out the first loops again with a pricker sufficiently for the purpose. The three strands are, as before, brought up in the centre and cut off short after whipping them together. This knot is also known as a stopper knot.

Crown Knot.

To make a Crown.—Pass the bights of the first and second strands over the second and third strands respectively, and dip the end of the third down through the bight of the first, and work the knot into shape. Its construction can be easily followed in the figure.

Double crowning is done by following round each strand again alongside its first lead.

The next two knots are but combinations of the wall and crown.

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Manrope Knot.

Is used for securing the upper ends of the gangway manropes. It is made by first forming a wall and then crowning it (Fig. 1).

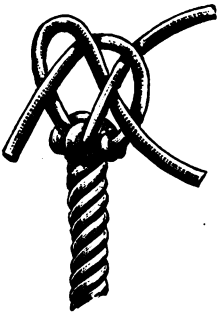

Fig. 1.

Then, follow round the wall again, and, lastly, follow round the crown, when the finished knot will appear as in Fig. 2.

Fig. 2.

Turk's Head and Stopper Knot.

Turk's Head Standing.—Make a wall and crown, and follow the ends round. Used for guest warps, knife lanyards, &c.

Stopper Knot.—Is used in the ends of stoppers, and is made by making a wall and half a wall, putting on a good

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whipping about two or three inches from the knot, and cut the ends off.

Stopper Knot.

Single Matthew Walker.

Is used for securing the standing part of a rope or making beckets for buckets, &c.

To make this knot commence similarly to a wall, but pass the first strand *a* under both *b* and *c*, as in Fig. 1.

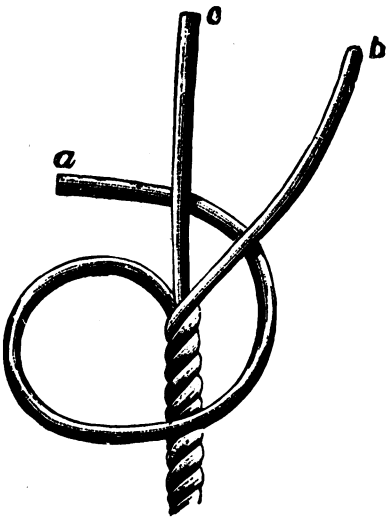

Fig. 1.

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Then pass *b* under both strands *c* and *a*, and bring up through the loop first formed by *a* (Fig. 2).

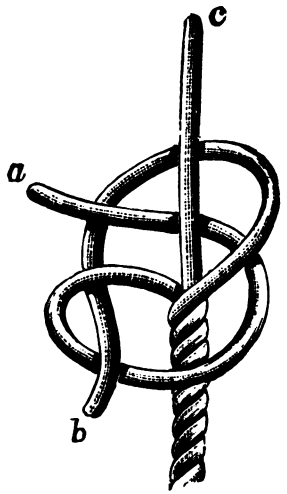

Fig. 2.

Similarly, pass *c* under *a* and *b*, and bring up through the loops first formed by *a* and *b* (Fig. 3).

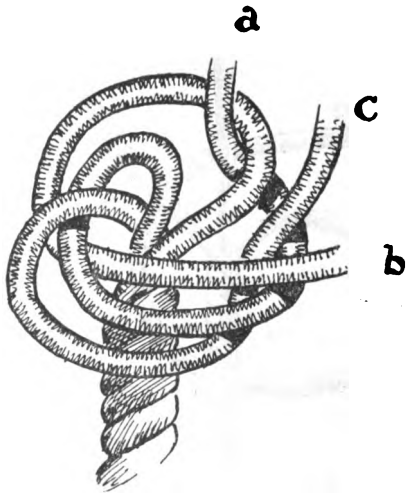

Fig. 3

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Double Matthew Walker.

Will be easily learnt if you notice the difference between a single Matthew Walker and a wall knot.

In the wall knot you will have noticed that each strand is simply interlaced with the strand immediately on its right coming up through the loop formed by this second strand.

In the single Matthew Walker each strand interlaces the two strands to its right, coming up through the loop of the third strand.

Another evolution in the same order brings us to the double Matthew Walker. It is formed, as will be seen by carefully following diagram 4, by making each strand contain its own loop, the other two strands, and *its own* end, that is, each strand leads up through its own bight after interlacing the other two.

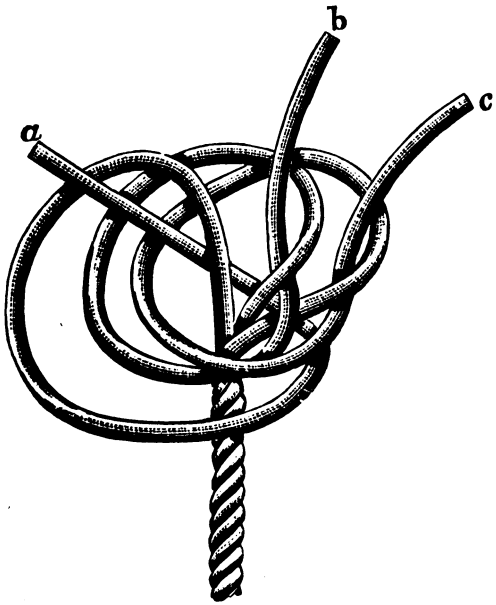

Fig. 4.

Fig. 5.

When worked taut and finished off, it will appear as in Fig. 5.

Single Diamond Knot.

To form it on a rope by its own strands, unlay the rope to the place where it is desired to form the knot, and as after the knot is made the strands will have to be laid up again, try to preserve the original lay in the strands as much

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as possible. Now bring each of the three strands down alongside the standing part of the rope, thus forming three bights, and hold them thus with the left hand. Take the first strand *a* (Fig. I.) and putting it over the next, *b*, bring it up through the bight of the third strand *c*.

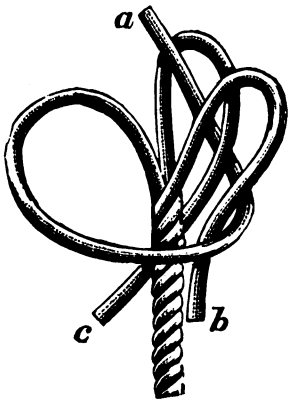

Fig. I.

Take the end of the second strand over the third and up through the bight of the first. The last strand is brought over the first and up through the bight of the second. Haul taut, and lay the rope up again. Fig. II. shows the loops in their places with the ends through them before they are hauled taut. Fig. III. gives the knot finished.

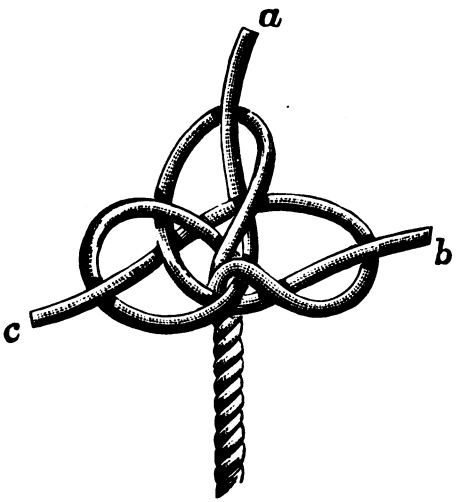

Fig. II.

Fig. III.

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Double Diamond Knot.

For a double diamond, first make a single diamond, the ends are then made to follow the lead of the single knot through two single bights, the ends coming out on top of the knot. The last strand passes through two double bights. The ends are then hauled taut and laid up as for the man-rope knot.

Shroud Knot.

Is a method of joining two ropes. Each is unlaid the necessary length, and they are then brought close together. A wall knot is formed on each rope with the strands of the other (Fig. 1).

The completed knot is shown in Fig. 2, but to make a neat job the ends should be marled and served as in Fig. 3.

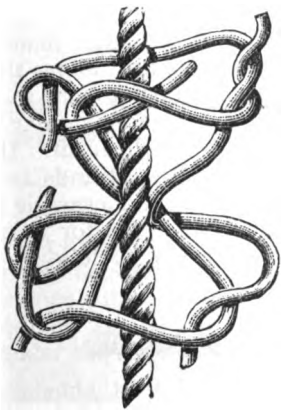

Fig. 1.

Fig. 2.

Fig. 3.

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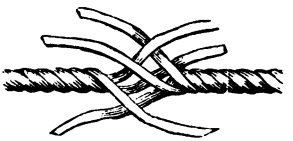
SPLICING.

Hemp Short Splice.

Hemp Short Splice.—A short splice is used for joining any rope not required to travel through a block, strops of blocks, &c.



Short Splice, 1st.

To make a Short Splice.—Unlay the rope to the required length, which is twice the circumference of the rope for the long ends, and once and a half the circumference of the rope for the short ends; when this is done, whip all the ends with a yarn, then marry them together, put a stop round the fork, the long ends are tucked in twice, and the short ends once, pass the left-hand strand over the first strand next to it, and underneath the second strand, haul it taut in the lay of the rope, then enter the right-hand

Short Splice, 2nd.

strand, and lastly the middle strand, in a similar manner to the first or left-hand strand; haul them taut along the lay of the rope, put the long ends in again as before, cut the stop off the fork and put the short ends in once in a similar way; stretch the splice, whip the ends, and cut them off. If it is intended to serve over the splice, put the strands in once and a half each way, take a few of the underneath yarns from each strand to fill up the lay of the rope for worming, scrape the ends, and marl them down ready for serving.

Short Splice, 3rd.

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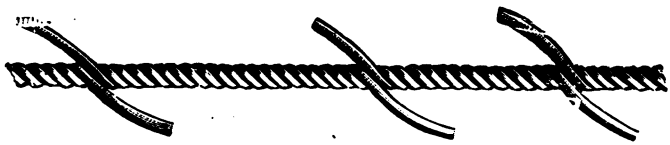
Long Splice.

Is used for splicing any rope that reeves through a block, when in use.

Long Splice, 1st.

To make a Long Splice.—Unlay the ends of the two ropes to the length of five and a half times the circumference of the rope, crutch them together in a similar manner to a short splice, unlay one strand, and fill up the vacant space which it leaves with the opposite strand next to it, then turn the rope round and lay hold of the two next strands that will come opposite their respective lays, unlay one, filling up the vacant space, as before, with the other. Take one-third out of each strand, and knot the



Long Splice, 2nd.

opposite strands together, and heave them well in place, stick all six ends once under one strand; having stretched the splice well, cut the ends off.

Eye Splice.

Bend the end of the rope down, having first opened the strands, leaving the middle strand on top of the rope.

Then dip the middle strand under the top strand from right to left.

The left-hand strand is then forced from right to left over the middle strand and under the next to the left. Now turn the rope round to the left so as to bring the remaining or right-hand strand on top of all, tucking it from right to left under the strand not already used.

Care should be taken to retain the lay of the rope in the last strand tucked, to enable it to lie closer.

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Dip all three strands a second time, and finish off in the following methods :—

For Strops.—Split the strands and take half of each, seizing them together and cut the ends off.

In all cases where serving is used the strands will be tapered off.

A Cut Splice.

Is made by laying two ropes in the position indicated in figure :—

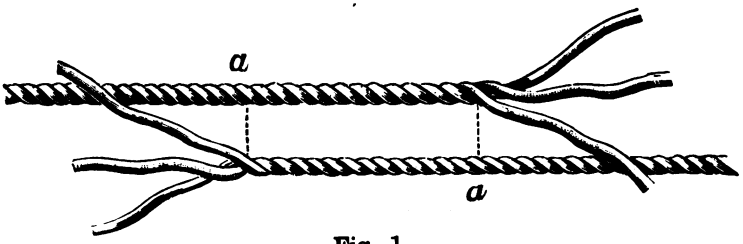

Fig. 1.

Leaving the ropes between *a a* to form an oblong loop, tuck the strands of one rope into the other as done in the eye splice. Splices are often wormed, parcelled, and served.

Fig. 2.

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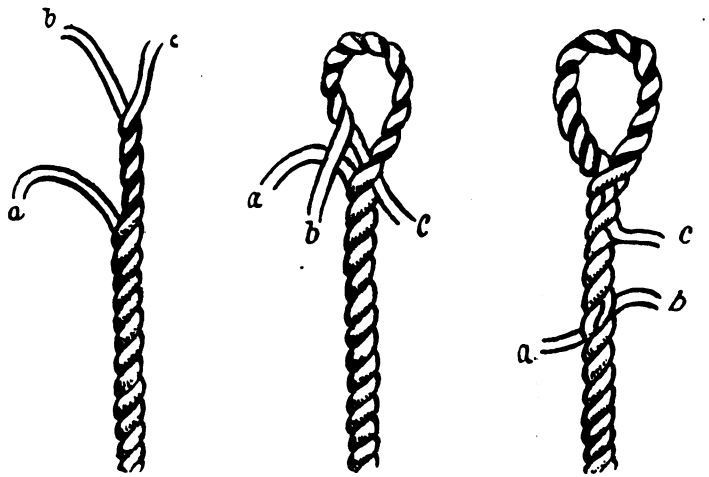
A Chain Splice.

Is used for splicing hemp tails into chain when required to travel through a block or fairlead, such as earrings and outhauls for forecastle and quarterdeck awnings.

To make a Chain Splice.—Unlay the strands rather more than for an eye splice, then unlay the strand (*a*) for a few inches. Reeve the two remaining strands (*b*) and (*c*) through the link in the end of the chain; continue unlaying the strand (*a*), and lay up strand (*b*) in its place for about a foot, then half knot it, and tuck as for a long splice. Then tuck strand (*c*) as for an eye splice.



To Point a Rope.

This is done to preserve the end of it.

Put a stop on at two and a half times the circumference of the rope from the end, which will leave about the length for pointing, unlay the rope to the stop, then unlay the strands, split a number of the outside yarns and make a nettle out of each yarn (a nettle is made by laying up the yarns with the finger and thumb left-handed); when the nettles are made, stop them back on the standing part of the rope; then form the point with the rest of the yarns, by scraping them down to a proper size with a knife, and marl them down together with twine; divide the nettles, taking every other one up, and every other one down; pass three turns with a piece of twine which is called the warp very taut round the part where the nettles separate, taking a hitch with the last turn, continue to repeat this, process by placing every alternate nettle up and down,

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passing the warp, or filling, taking a hitch each time until the point is to its required length; you can either form a bight with the last lay by passing the warp through the bights, haul them taut, and cut them off; or work a becket in the end by taking a small piece of rope one-fourth the size of the rope, form a bight, unlay the ends, and twist the six strands up again by twos, taking some of the inside yarns and lay them up as rope, then short splice that and the becket together and marl it down.

To Graft a Rope.

Tuck the strands for the eye once, then take a sufficient number of the underneath yarns to worm the rope, and proceed as in pointing.

A point or graft when finished should be the circumference of the rope in length.

To make a Selvagee Strop.

Drive a couple of bolts or large nails into a piece of plank, or any convenient place, or else seize a couple of hooks which will answer the same purpose; put the nails or hooks at the required distance apart, according to the length of strop you want, take the ends of the ball of rope-yarns and make it fast to one of the spikes or hooks, then

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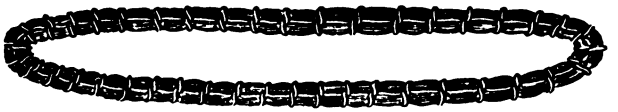
take it round the other one, keep passing roundabout turns, taking care to have every turn well taut until the strop is to the required thickness. If it is to be a very large strop, marl it down with spunyarn; if a small strop, two-rope yarn.



Selvagee.

To Whip a Rope.

The end of a rope must always be secured in some way, or it is evident from its construction that it will on the slightest usage become frayed out. The commonest method is by placing on an ordinary whipping, which is done as follows:—First lay the end of a length of twine along the end of the rope, and then commencing at the part furthest from the rope's end take a half dozen or more turns around both the rope and twine end (Fig. 1). Then lay the twine in the form of a loop along the rope and over the turns already taken, as in Fig. 2. To finish off take that portion of the loop designated *a*, and continue taking turns tightly round the rope and part *b* of the twine until the loop is nearly all used up; pull through the remainder snugly by part *c*, and cut off short when no end of twine will be visible, as in Fig. 3.

Fig. 1.

Fig. 2.

Fig. 3.

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A West Country Whipping.

Is formed by middling the twine around the part of the rope to be marked and half knotting it at every half turn, so that each half knot will be on opposite sides. When a sufficient number of turns are passed, finish it off with a reef knot.

An American Whipping.

It is commenced in the same way as a common whipping, but finished off by leaving both ends out in the middle of the whipping, and forming a reef knot. This is done by leaving the first end out, when you commence to pass the turns on the bight over the last end.

To Splice Three and Four-Stranded Rope together.

For a short splice, divide the 4-inch strand into three parts, and lay one part in with each of the three strands. In a long splice, work three strands in as usual, and when finished put the fourth strand in where it lies.

A splice weakens a rope about one-eighth.

Three-stranded rope is one-fifth stronger than four-stranded.

A Grommet.

To make a Grommet, cut a strand about three and a half times the length of the grommet required. Unlay the rope carefully and keep the turns of the strand in. Close up the strand in the form of a ring (Fig. 1), and then pass the ends round and round in their original lay until all the intervals are filled up (Fig. 2), and then finish off the two ends as in a long splice (Fig. 3).

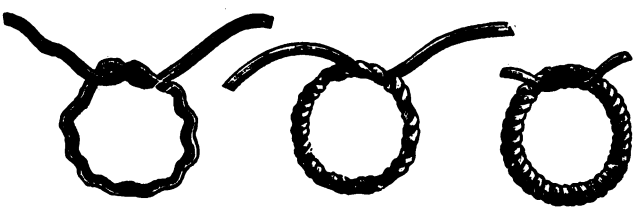

Fig. 1. **Fig. 2.** **Fig. 3.**

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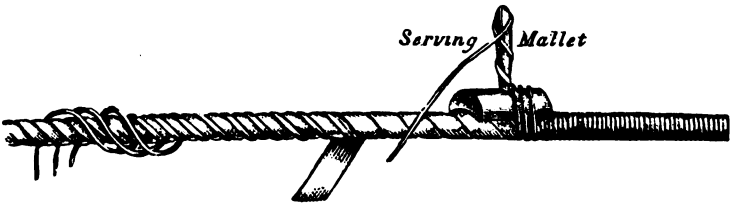
To Worm, Parcel and Serve a rope is to preserve it from wet or chafe.



Worming. Parcelling. Serving.

Worming is done to fill up the space between the strands of the rope with spunyarn or small rope, to render the surface smooth and round for parcelling and serving.

Parcelling a rope is laying round it with the lay of the rope strips of old canvas, tarred, from 2 to 3 inches wide, according to the size of the rope, before serving it, the upper turn of the parcelling overlapping the upper edge of the turn below it.

Serving.—The service is of spunyarn put or hove on by a serving mallet; the latter has a score in the underpart according to the size of the rope, so as to lay on the rope, and a handle about 15 inches long. Service is always laid on against the lay of the rope; a man passes the ball of spunyarn, taking the turns well out of it, at some distance from the man that is serving the rope. When the required length of service is put on, the end is put under the last two turns, hauled taut, and cut off. All standing rigging, or any other rope likely to be chafed, is always served.

Worm and parcel with the lay
And serve the rope the other way.

To work in the worming of a rope (that is not going to be parcelled or served) so that it cannot come out when the rope is worked into an eye, &c., a strand of yarns knotted as a bale sling is middled and passed over the rope; the ends are dogged opposite ways, and the handle of the serving mallet passed through them, thus forming a type of Spanish windlass. The strand is then worked along the rope with the lay, and it will be found that the worming by this means is considerably tautened. The strand should be lightly greased to allow free movement.

Steel Wire Rope.

The wires and strands are laid up in opposite directions, evenly and uniformly as regards size and angle. Steel wire rope contains a hemp core, or heart, round which the strands

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are formed. All wire rope contains a jute yarn, as an Admiralty identification mark.

Wire rope is measured in inches by its circumference, and is supplied in coils.

There are several kinds of wire rope used in H.M. Service, viz. :—

Steel wire rope, for standing rigging, $4\frac{1}{2}$ inches to $1\frac{1}{2}$ inches, 6 strands, right-handed.

Flexible steel wire rope, for hawsers and running rigging, 8 inches to 1 inch, 6 strands, right-handed, each strand contains a hemp heart.

Extra special flexible electro-plated rope, for ammunition hoists, &c., 5 inches to $\frac{3}{8}$ inch, 6 strands, right-handed, each strand contains a wire heart of the same size and quality as the wires forming the strand, except the $\frac{3}{8}$ inch, which contains a jute heart.

Plough steel wire electro-plated rope, for boat hoists, 6 inches to 1 inch, 6 strands, right-handed, each strand contains a wire heart of the same size and quality as the wires forming the strand.

Flexible steel wire rope, for torpedo nets, $\frac{3}{4}$ inch, 6 strands, right-handed, supplied in coils of 300 fathoms, breaking strain, 1 ton.

Flexible steel wire rope, for rammer indicators, $\frac{3}{8}$ inch, 5 strands, right-handed, supplied in coils of 100 fathoms, breaking strain, $\frac{11}{20}$ of a ton.

Flexible steel wire rope, for sinkers, $\frac{7}{8}$ inch, 6 strands, right-handed, supplied in coils of 151 fathoms, breaking strain, 2·5 tons.

Flexible steel wire line, for lacings, earrings, &c., $\frac{7}{8}$ inch, 6 strands, right-handed, supplied in coils of 100 fathoms, breaking strain, $1\frac{3}{4}$ tons.

Flexible mild steel wire line, for seizings, $1\frac{1}{4}$, 1, $\frac{3}{4}$, and $\frac{1}{2}$ inch, 4 strands, right-handed; $\frac{3}{8}$ and $\frac{5}{16}$ inch, 1 strand, left-handed, supplied in coils of 100 fathoms, breaking strain in cwts., 21, 13, 8, $5\frac{1}{4}$, $3\frac{1}{4}$, and 2 respectively.

Flexible mild steel wire line, for fitting splinter netting, $\frac{7}{16}$ inch, 5 strands, right-handed, $\frac{3}{16}$ inch, 1 strand, left-handed, supplied in coils of 100 fathoms, breaking strain in lbs., 430 and 90 respectively.

Flexible steel wire line, for wireless telegraphy, in torpedo boat destroyers, ·207 inch, 7 wires in line, supplied in coils of 150 fathoms, breaking strain 650 lbs.

Wire Splicing.

In splicing wire rope, great care should be taken to prevent kinks getting in the rope or strands.

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With steel wire rope, always before working it put a stop on at the place to which you intend to unlay, and also put a good whipping of twine at the end of each strand.

In splicing wire all tucks are made against the lay of the rope.

In making an eye splice the rope is handled better if hung up in a convenient position, so that when standing up the eye will be at about the level of the chest of the person working.

A long tapering steel marline-spike is required, and after placing it under a strand do not withdraw it until the tuck is made and all the slack of the strand drawn through.

To make a neat splice do not haul the part of the rope that has not been unlaid too close to the neck of the splice, and in tucking the strands never take a short nip, but take long lays.

In unlaying for a long splice always unlay two strands simultaneously to keep the rope in its original lay. For a fair-sized rope unlay about 9 feet of each end.

Proceed as in rope-splicing, and after the three pairs of strands are in their places, single them and continue to unlay and lay-in until the six meeting places of the strands are equi-distant.

To finish off the ends properly can only be learned by observation and actual practice. By using two marline-spikes, the hempen heart is removed and the ends of the wire strands forced into the place it occupied, making a very neat job when finished.

Wire splices should l e parcelled with oily canvas and served.

Short Splice.

The same procedure is gone through as for splicing hemp rope, only care must be taken to place a good whipping on where the ends marry, also that each strand prior to unlaying is whipped, the number of tucks taken should never be less than three whole, and one half, and one third, so as to taper the splice off.

NOTE.—The number of tucks to be taken vary according to the work required of the rope or strop, but as a rule the more the better.

In tucking wire strands the strand should be entered in front of the marline-spike, which should not be withdrawn until this has been done, care being taken not to kink the strand.

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Eye Splice.

Mark the crown of the eye, take half the girth of the thimble and rope to be used, and put a good stout whipping on to the wire, break the wire into the shape of the thimble and heave both parts of the wire together by means of " rigging screws " supplied for this purpose ; put a good seizing of spun yarn around both sides of the wire and thimble at the ends of the latter, and then remove the " rigging screws " and unlay the end of the wire as far as the whipping, open each strand and remove the hemp heart by cutting it off ; then put a whipping on the ends of the six strands, commence the splice by tucking the right-hand strand first, then the others in succession, each strand under one ; the left-hand strand being the last is tucked under two, this means ensures that each strand takes a fair strain, care should be taken to keep the strands straight ; when all have been tucked once, beat well down with an iron hammer and put on a good seizing of spun yarn, then tuck each strand a second time.

2½-inch wire and above should be tucked three times full and tapered to a third.

Steel Wire Hawsers.

The splices of the wire are made against the lay of the rope tucked three times with the full size of the strand, and a fourth time with the strand reduced one half to make a suitable taper, each tuck is drawn tightly in the direction of the lay of the rope. The centre core of the rope is removed on opening out the strands for splicing, and the cores of the strands removed after the first tuck has been made. The first tuck is taken at one and a half times the girth of the thimble plus the circumference of the rope. The splice is then parcelled and served, the thimble tightly seized in with a flat seizing, crossed.

Splicing Wire Rope into an endless band.

This can be done by either the long or short splice, but the former is recommended, as the short splice, though equally strong, leaves a thick place in the rope. In the long splice, if properly made, no such inequality exists, indeed the spliced part should be difficult to locate.

The following instructions as to how to make a long splice will be found useful :—

First of all, a rope say 3½-inch circumference should have a splice not less than 60 feet, to be safe, and smaller sizes in

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proportion, down to 1½-inch circumference, for which size 25 feet would do.

Take the 3½-inch rope as example :—

Measure 30 feet off each end of your rope and put a sound marline serving at these points. Then cut off the end servings and tie the strands together in twos, thus—

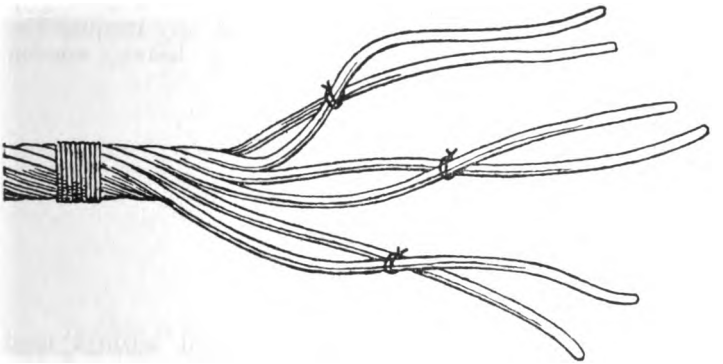

Fig. 1.

and inter-lock as shown. Lashings should only be cut off when parts are quite close together, as, otherwise, rope has a tendency to open out further back, and thus throw length wrong. Then open strands out singly, and snip off short six of the ends, three on either side alternately. That is to say—leave a long end in each case, opposite one of the snipped ends. Take each of the short ends in turn and carefully unlay them, at the same time laying in its place the corresponding long end.

This should be done with all the strands, and reckoning from the centre on each side, first one should be taken away 25 feet, second 15 feet, and third 5 feet. This will divide your splice up equally, as shown :—

Fig. 2.

Then commence at first strand at either end. First put a marline-spike through centre of rope where the ends cross, and cut and remove hemp heart for a foot or so, then

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by the aid of two spikes force the strand into place of heart just removed, and follow up to the end of strand, pulling out heart a few inches at a time.

Repeat with all 12 ends, taking care that no empty space is left in centre of rope by cutting of hemp core further away than strand end will reach. It is a good plan to marl or wrap each end with parcelling before it is put into centre of rope, as this tends to give parts of splice a good grip of one another. To finish off and remove any inequalities, lay splice on deck and hammer with a heavy wooden mallet.

SEIZINGS.

Round Seizing
Flat Seizing
Racking Seizing
} are the three principal seizings used in the Service.

Round Seizing.

This seizing is used where the stress on both parts of the rope is equal, such as strops of blocks, seizing the eyes of rigging, &c.

To Pass Round Seizing.

Splice an eye in one end of the seizings, take it round both parts of the shrouds, and pass seven turns, working towards the standing part of the shroud, reeve the end back between the turns of the seizing already passed (which are called the lower turns), and up through the eye of the standing part of the seizing, and it will be in the right position to commence passing the six upper turns, or riding turns, which will exactly come between the parts of the lower turns; care should be taken to heave each lower turn of the seizing well taut by means of a Spanish windlass, and the upper turns well taut by hand. After passing the sixth and last riding turn, pass the end down between the last turn of the lower turns, and heave it hand taut. Then take a round turn round all parts of the seizings, heave it well taut with a *Spanish windlass*, and secure with a clove-hitch, one part of the clove-hitch being each side of the round turn, after which unlay end of seizing and make crown

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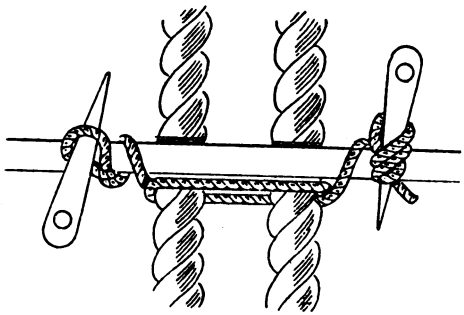
first and wall underneath it. Any number of lower turns can be taken, the riding turns must always be one less in number.



Spanish Windlass.

Flat Seizing.

Is only a light seizing, and is commenced the same way as a round seizing, but on the end being rove through the eye no riding turns are taken, but finish off in the same manner as for the round seizing.

Racking Seizing.

Used where the strain is on only one part of the rope.

An eye splice is formed in one end of racking and the first turn is passed round both parts of the rope like a round seizing, it is then dipped between both parts and the remaining turns are passed as racking turns, over and under, leaving sufficient space between each racking turn for a roundabout turn to lie, the usual number taken being 13; after these are passed the end is dipped down inside of the last turn, the roundabout turns are passed from the end towards the eye between the racking turns; when the last roundabout turn is passed, the end is passed up between both parts of the shroud, ready for passing the cross turns, which are passed by taking the end along the seizing and passing it down between the seventh and sixth turns along the seizing, again towards the eye, up between the two parts of the shroud as before, and again drawn between the seventh and sixth turns so as to form a clove-hitch; then finish off with a crown and wall, as in other seizings.

NOTE.—To make the racking neater after passing the last roundabout turn, the end is taken outside all parts of the racking instead of between the six and seven turns, and clove being formed at the same time.

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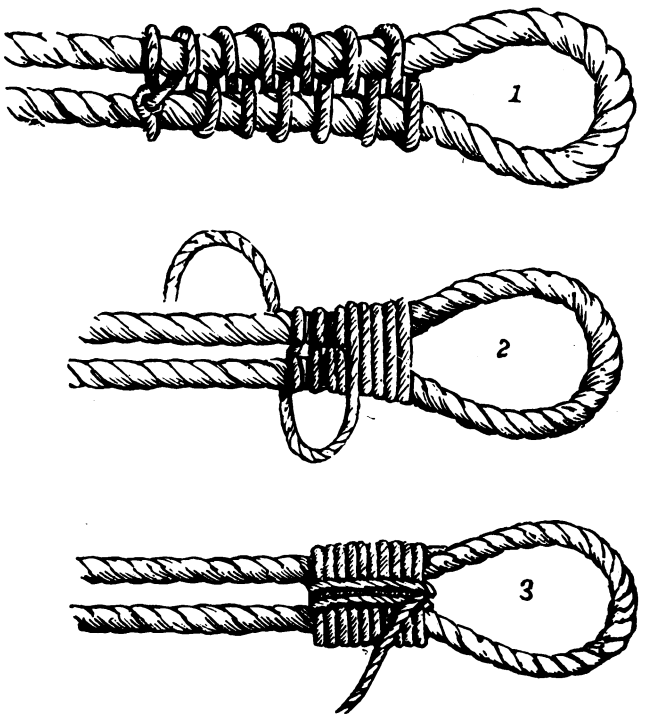
RACKING SEIZING,
Forming a Flat Seizing as used for Wire Rigging.



ROPEMAKING.

Yarns are made from hemp laid up right-handed; each yarn bears, in the case of tarred rope, from 70 to 140 lbs., and for white rope, 87 to 160 lbs.

Strands consist of a number of yarns formed together, the number depending on the size rope formed; those intended for a right-handed rope are formed left-handed, and those for a left-handed rope are formed right-handed.

Hawser-laid Rope.—There are several descriptions of hawser-laid rope; it is used for running rigging, for hemp hawsers, and for small boats' cables; it is made into white rope, as well as tarred; coir rope used for drift lines and for various other purposes is hawser-laid.

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Spun Yarn is a number of yarns, twisted up right-handed. The number varies from two to eight. Spun yarn is made up in pads of 28 and 56 lbs.

Nettle Stuff is made of two or three yarns laid up together. It is used for clews of hammocks, for making harbour gaskets, and other purposes.

Sennit is made of a number of yarns, plaited up into square, round, or flat sennit as required, and used for various purposes.

Junk consists of lengths of condemned cordage, "four-inch" and above.

Rounding is condemned running rigging, under "four inch." It is supplied for lashings and other purposes, where good rope is not required, and for making wads, &c.

Oakum is old rope unlaid, and the yarns picked into hemp for caulking the seams in a ship's deck or side, and for many other purposes.

Four-stranded Rope.—Cordage hawserlaid tarred, made from Riga hemp from 3½ to 2 inches, and supplied in coils of 106 fathoms; used for shrouds, stays, Jacob and bottom ladders, &c.

Boltrope.—Cordage tarred and white, made of Italian hemp, from 6 inches to ½ inch as required, and supplied in coils of 122 fathoms. The rope is soft laid and well-stretched before making into coils to render it soft and pliable; used for roping of sails and awnings.

Hammock Lashings and Lanyards.—Cordage, white, made of Italian hemp, 1¼ inch, and supplied in coils of 120 fathoms.

Stage Lashing, cordage tarred, is pliable rope from 4½ to 1½ inches, made from new hemp, soft laid; used for slings, lashings, staging, &c. It is supplied in coils of 125 fathoms.

Coir Rope is three-stranded right-handed rope. The yarn is spun from the fibres of the cocoa-nut tree.

It is one-third lighter than hemp rope, but not nearly so durable; it soon rots after being wet, if not well dried before being stowed away; as it floats so light, it is very useful for warps, and is about a quarter the strength of hemp rope.

Twine is made from the finest hemp.

Deep-Sea Lead Line is 1-inch cable-laid rope supplied in lengths of 42 fathoms.

Hand Lead Line is 1⅛-inch rope of white hemp, supplied in coils of 113 fathoms.

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Patent Log Line is supplied in lengths of 40 fathoms.

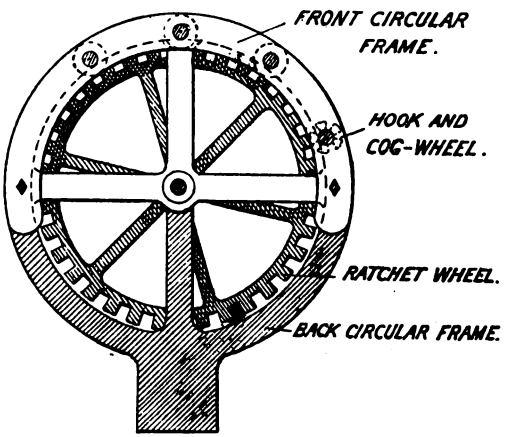
Signal Halliards are white hemp soft laid, with one-sixth of the yarns reverse spun so as to get flexibility. They are supplied in lengths of 122 fathoms, in three sizes—$\frac{3}{4}$, $1\frac{1}{8}$, and $1\frac{1}{4}$.

To Make a Fox.—Make two or three yarns fast to a belaying pin, or some other convenient place, stretch them out taut, and twist them together, then rub down smooth with yarns, or a piece of old canvas; it is used for making gaskets, mats, plaits, and temporary seizings, &c., and many other purposes.

To Make a Spanish Fox.—This is made by taking a single rope-yarn, making one end fast to a belaying pin, untwisting and twisting it up again the reverse way, and rubbing it smooth with a few yarns or a piece of canvas. It is generally used for small seizings.

TO MAKE ROPE.

Rope Jack.



Rope is made by means of a rope jack, which will make either 3 or 4-stranded rope.

It consists of double circular framing, between which is introduced a circular cog. There are five hooks in the frame, four on the circumference and one on the centre; the shanks of these hooks pass through small cog wheels, and are connected to them by feathers and featherways, and they are worked by the ratchet wheel, which is revolved by means of a handle. To bring the hooks into gear a strain must be put upon them.

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The hooks on the circumference are used for laying up the yarns and strands, and the centre one for hardening up the rope afterwards.

In addition to the jack, a "Luper" or swivel hook is used to twist the strands together, and a "Top," or conical piece of wood with grooves to take the strands, regulates the amount of twist given to the rope.

25-thread yarns are used in all rope from 6½ inches and above.

30-thread yarns are used in all rope from 3½ to 6 inches.

40-thread yarns are used in all rope from 3 inches and below.

20-thread yarns are used for stage lashings of all sizes.

All hemp rope made in Government yards is marked by a distinguishing yarn of coloured jute, laid up with the other yarns, viz. :—

Devonport	–	–	–	"Red" Yarn.
Chatham	–	–	–	"Yellow" ,,

When laying up 4-stranded rope a heart is placed in the centre to make the strands lie evenly.

Manufacture of Cordage Hawserlaid.—The hemp is placed on the spreading machine and passes through rollers, and is delivered gauged into cans. The cans with the hemp are then weighed up into sets according to the size yarn required. The hemp then passes through the first, second, and third drawing machines, which clean it, and unite the fibre. It is then spun into yarn on small bobbins and rewound on reels for tarring. The yarns are then passed through a kettle containing boiling tar, and warped on large drums in hauls of 15-cwt. each. It is then placed in store for 15 months for seasoning.

After this time, the yarn is drawn from store and reeled on bobbins, the strands formed, a Government mark inserted in each strand for 1½-inch rope and above, and one mark in rope of 1¼-inch and below. The strands are then laid up into cordage, made into coils, and a sample of each tested to destruction.

The test is made on specimens 2½ fathoms in length, with one clear fathom from stop to stop. When under test, if a break occurs at a strain less than the standard breaking strain, the rope is rejected.

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Cordage, Hawserlaid, White, is not treated with tar, and is about 10 per cent. stronger than tarred rope.

Reverselaid Rope is made of Italian hemp. The process is the same as for hawserlaid rope until forming the strands, when the process is reversed, the strands not being formed so hard. It is a strong pliable rope, laid up left-handed, and is used for gun tackles, &c. It is not manufactured now.

Hemp Hawsers are made in coils of 113 fathoms, being stowed on reels supplied for that purpose.

They vary in size from $3\frac{1}{2}$ inches to 8 inches.

They are generally pointed at both ends and fitted with a becket after being drawn from the yard.

The bottom inside end of a new coil should be taken out first.

Rope is measured by its circumference.

The following is a rough method of finding the breaking, proof, and working strain of a hemp rope, up to 6-inch :—

Square the size of the rope and divide consecutively by 3, 4, and 6. For instance, 3-inch rope :—

Breaking Strain.	Proof Strain.	Working Strain.
$\frac{(3)^2}{3} = 3$ tons.	$\frac{(3)^2}{4} = 2{\cdot}2$ tons.	$\frac{(3)^2}{6} = 1{\cdot}5$ tons.

Above 6-inch the factor is $3\frac{1}{3}$ for the breaking strain.

Rope will reeve through an ordinary block three times its size.

Rope will reeve through a clump block twice its size.

Coir Rope is made in a similar manner to hemp rope. It varies in size from $2\frac{1}{2}$ inches to 8 inches (there is also one of 15 inches used for towing battle practice targets). Every ship is supplied with a certain number of hawsers.

Its strength is one-quarter that of hemp rope of similar size, and its weight about one-third lighter.

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Table of Hemp Rope, &c., and Breaking Strains.

(*According to Admiralty Requirements.*)

Size.	Breaking Strain in Tons.
Hemp Rope.	
Inches.	
14	60
13½	55½
13	51
12½	47
12	43½
11½	40
11	36½
10½	33
10	30
9½	27
9	24
8½	21½
8	19½
7½	17
7	14¾
6½	12¾
6	11½
5½	9¾
5	7¾
4½	6½
4	5
3½	3¾
3	3
2½	2
2	1 7/20
1¾	1
1½	¾
1	8/20

Size.	Breaking Strain.	
Stage Lashing.		
Inches.	Tons.	cwt.
4½	6	5
4	4	18
3½	3	15
3	2	15
2½	1	18
2	1	5
1½	–	14

Breaking strains nearly that of cordage hemp rope tarred.

Coir Rope.

Inches.	Tons.	cwt.
8	5	2
7	4	0
6	3	0
5	2	2
4	1	7
3	–	15
2½	–	10½

Breaking strain equals $\frac{(\text{circumference})^2}{12}$ approximately.

Wire Rope.

All wire rope is six-stranded, and steel wire is invariably used. It is laid up on the same principle as for making hemp, but by machinery.

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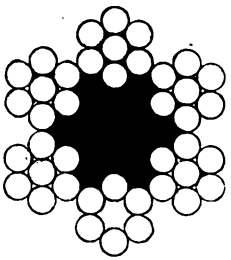
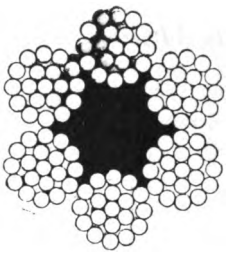
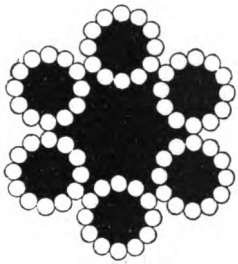
Sections of Steel Wire Rope.



S.W. rope for standing rigging, 1 to 3½ inches.



S.W. rope for standing rigging, 6½ to 4 inches.



Flexible steel wire rope, 4½ inches and below.

Wire rope is measured by its circumference.

Flexible Steel Wire Rope.—Each strand has a hemp heart, and the strands themselves are formed round a hemp heart. In wire rope used for rigging, &c. the heart of each strand is formed of wire, and the strands are formed round a hemp heart.

Wire before being laid up into rope is—

(1) Tested.
(2) Cleaned in acid.
(3) Galvanized.
(4) Passed through a bed of sand or asbestos.
(5) Tested again.
(6) Wound on reels.

The wire used to form the strands varies in size according to the dimensions of the rope required.

The tests to which steel wire rope is subjected are—

(1) Tensile test, *i.e.* stretching.
(2) Torsion test, *i.e.* twisting.
(3) Ductility test, *i.e.* bending without breaking.

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(1) **Tensile Test.**—About 2 fathoms of rope are cut off and by means of hydraulic power tested to the required breaking strain.

Fourteen wires are then unlaid to be tested, seven for torsion and seven for ductility.

(2) **Torsion Test.**—Each of the seven wires selected is tested separately. One end of the wire is held rigidly in a small machine which is then revolved so as to take about 25 turns (the number of turns varies with the size of the rope). The wire should show no signs of breaking. If two of the wires fail, the rope would probably be rejected.

(3) **Ductility Test.**—Each of the second set of seven selected wires is separately tested.

One end of the wire is clamped in a kind of vice, the other end is then rove through a ring or over a hook close to the vice and twisted round its own part about eight times (the number varying with the size of the rope); it is then untwisted and should show no signs of breaking. If two of the wires fail, the rope is probably rejected.

Wire Hawsers supplied to ships in H.M. Navy vary in size from $2\frac{1}{2}$ inches to $6\frac{1}{2}$ inches.

They are supplied in lengths of 150 fathoms, with a thimble in each end.

They are stowed on reels fitted with brakes supplied specially for that purpose.

A 1-inch wire hawser is also supplied 300 fathoms long for towing targets.

Testing Long Lengths of Wire.

(*See* Sketch.)

To Test the Rope.—For the first pull take five turns of the wire round the drum shackled to the ram, and shackle the end of the wire to the opposite end of the trough. Clamp the wire and apply the test. To test the remainder of the wire take five turns round the second drum, clamp the wire and apply the test.

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Method of testing long lengths of steel wire rope.

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Table of Wire Rope and its Breaking Strain.

(According to Admiralty Requirements.)

Flexible Steel Wire Rope for Hawsers and Running Rigging.					Extra Special Flexible Steel Wire Rope, Electro-plated.					Steel Wire Rope for Standing Rigging.					Extra Special Flexible Plough Steel Wire Rope for boat hoists.	
Size of Rope.	Length of Coil.	Wires in a Strand.	Weight per Fathom.	Breaking Strain.	Size of Rope.	Length of Coil.	Wires in a Strand.	Weight per Fathom.	Breaking Strain.	Size of Rope.	Length of Coil.	Wires in a Strand.	Weight per Fathom.	Breaking Strain.	Size of Rope.	Breaking Strain.
Ins.	Fms.	No.	Lbs.	Tons.	Ins.	Fms.	No.	Lbs.	Tons.	Ins.	Fms.	No.	Lbs.	Tons.	Ins.	Tons.
8	150	30	53	170	5	100	37	23·5	89	6½	100	19	40	106	6	150
6½	150	30	35	112·7	4½	100	37	19	72	6	100	19	34	90	5¾	137
6	150	30	31	96·6	4	100	37	15	57	5½	100	19	28	76	5½	125
5½	150	24	28	81·6	3½	100	37	11·5	43	5	100	19	23	63	5¼	115
5	150	24	23	67·8	3	100	37	8·5	31·5	4½	150	19	19	51	5	105
4½	150	12	15	44·8	2¾	200	37	7·2	26	4	150	19	15½	40	4¾	94
4	240	12	12	35·6	2½	250	37	5·9	20	3½	150	7	11½	32	4½	85
3½	360	12	9	27·6	2	250	37	3·8	14·2	3	200	7	8	24	4¼	75
3	360	12	7	19·5	1¾	250	37	2·9	10·5	2½	200	7	6	16	4	67
2½	750	12	4½	13·5	1½	250	37	2·1	8	2	200	7	4	10	3¾	59
2	750	12	2⅝	8	1⅜	250	37	1·8	6·6	1¾	200	7	3	8	3½	51
1¾	300	12	2	6·3	1¼	250	37	1·5	5·25	1½	200	7	2	6	3¼	44
1½	300	12	1¾	4·6	1⅛	250	37	1·2	4·25						3	38
1¼	300	12	1¼	3·3	1	250	37	0·95	3·5						2¾	31
1	300	12	⅝	2				Ozs.							2½	26
					⅞	100	37	10	1·5						2¼	21·5
					⅝	100	24	4½	1·0						2	16·15
					⅜	100	24	2	0·25						1¾	12·15
															1½	9·5
															1¼	6·5
															1	4·2

NOTE.—4½-inch wire rope for Standing Rigging is the largest now issued.

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Rough Rule for ascertaining the Strength of Steel Wire Rope.

Breaking strain for rigging wire – (Circumference)^2 × $2\frac{1}{2}$ = result in tons.

Breaking strain for flexible wire – (Circumference)^2 × 2 = result in tons.

(For hawsers above $4\frac{1}{2}$-inch the factor should be $2\frac{1}{4}$ instead of 2.)

Working strain – Generally about $\frac{1}{5}$ breaking strain.

The diameter of sheave required for a F.S.W. rope is at least 6 times the size of the rope.

Wire Strops.

Are supplied for securing wire hawsers, &c. to bollards; they vary according to the size of the hawser used.

To make the Strop.

The strop should be married at 14 foot and tucked four times each way, the strands being attenuated at each tuck; the splice should be served over and lie around the thimble. A half turn should be taken out of the wire before marrying the strands.

To make a Gromet Strop.

The strop is made from a single strand of wire of sufficient length to form four parts; in forming the strop the working end should be kept the same side of the standing end; when formed, finish off by removing the hearts, crossing the strands, and tucking them under two.

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Test of Flexible Steel Wire Strops.

Size of Strop.	Size of Hawser.	Diameter of Bollard, &c.	Breaking Stress of Hawser.	Stress at which Strop parted.	Remarks.
Ins.	Inch.	Ins.	Tons.		
2½	2½ and 3	17½	17	26⅞ tons, or 58 per cent. above breaking strain of 3-inch rope.	Stress gradually applied, strop parted at last tuck of splice.
3½	3½, 4, and 4½	17½	39	55¾ tons, or 53 per cent. above breaking strain of 4½-inch rope.	Length of strop 50¾ inches; after 42 tons test was 52 inches, strop parted at last tuck of splice.
4½	5 and 5½	4⅝ bolt	71	66 tons, or 7 per cent. less breaking strain of 5½-inch rope.	Tested over a shackle bolt, parted at back of bolt.
5	6 and 6½	11 barrel	98	121¾ tons, or 24 per cent. above breaking strain of 6½-inch rope.	Tested over an 11-inch barrel, strop parted at a point just leaving the barrel.

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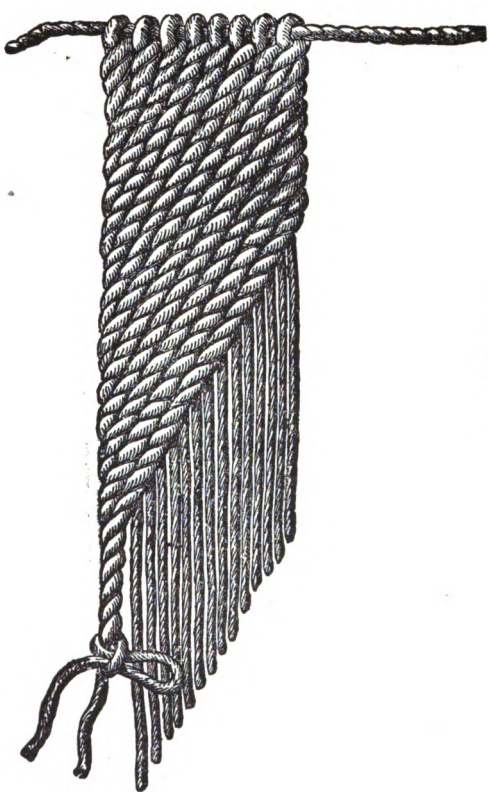
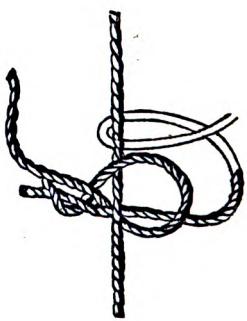
MATMAKING.

A paunch mat is used as a protection from chafe. To make the mat, stretch a piece of rope, according to the size of the mat required, in any convenient place, in a horizontal position, and the foxes which are used for making the mat are middled and hung over it, close together, from end to end, or as far as the width required for the mat. Then take the fox nearest the left hand and twist a turn in the two parts; one part give to the man opposite. The next fox has a turn twisted in its two parts, and one part given back to your partner; the remainder is twisted round the first, which is given back, and then again round its own part; and so on with the remainder of the foxes until you get it the breadth required. The bottom of the mat is selvaged by taking a piece of rope the same size as used for the top. The two parts of the foxes which are twisted together at the bottom are divided, and the piece of rope put between them; the foxes are hitched round it, and the ends put through its own lay with a marline-spike.





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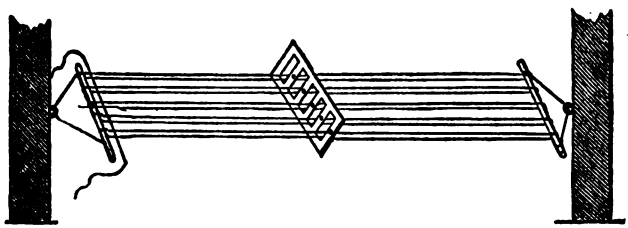
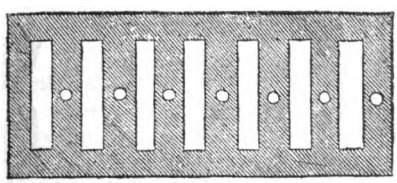
Sword Matting.

Sword matting is used for boats' gripes, &c., and is made as follows :—

According to the length of mat required, two iron bars are slung in a horizontal position at the required distance apart for warping the mat off; hitch one end of the warp (which is composed of spunyarn) to the bar at the end on which you intend to finish the mat. The other end is then rove through the first hole in the loom over and under the other bar, from which end you will commence, back through the first slit, over and under the other bar, and continue to wind off as many parts as are required for the breadth you have decided on making the mat, the last turn being rove through a slit and secured to the bar at which you finish off; this done, lift the loom up, middle the fittings, and lay it between the upper and lower parts; then lower the loom, and the parts that were lowest will rise in the slits and become the uppermost, and thus put a cross in the warp.



A piece of wood made in the shape of a knife, called a sword, is then inserted between the alternate parts of the warp, and the crossing is driven close to the head against the bar over which the warp for weaving the mat is passed; then a turn of filling is passed to secure the crossing, reeving the ends through contrary ways; haul it



taut, take out the sword, lift the loom up, and continue to pass the filling, half knot it with two turns. To finish off splice the mat.

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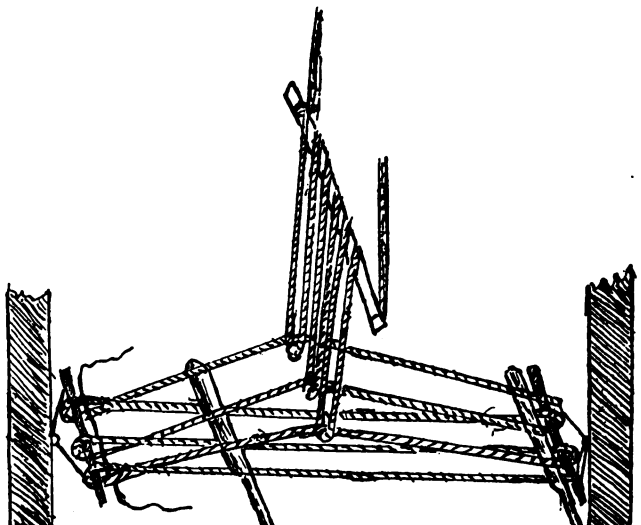
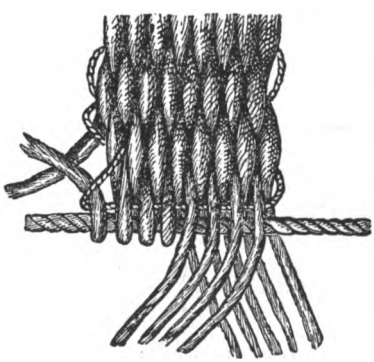
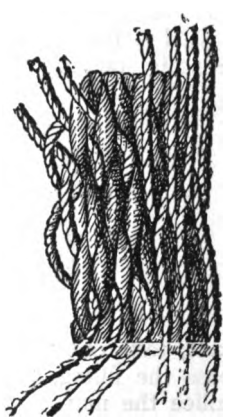
The loom is generally made of a piece of copper sheet with alternate holes and slits in it.



To Splice a Sword Mat.

Unlay 6 or 7 inches of mat, open the ends out, marry them together, laying one up and one down flat along the mat, withdraw the nettles on one side of one mat and point the nettles of the other mat through the holes they came out of; all ends will then disappear from that side, and there will be four rows of ends on the other.





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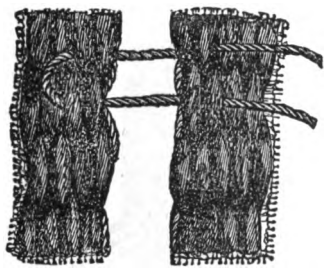
Turn the mats over, pick out the proper nettles of the side which have been married together, withdraw the ends belonging to one mat, and introduce the corresponding ends of the other mat through the holes, thus repeating the same operation on each mat, and on each side there are now two rows of ends; marry those together on each side, laying one up and one down, and go on splicing by withdrawing and reeving for two or three rows more in each mat. Leave off with the ends all out on the same side, and finish off as with selvaging.

A cobbler's stitch is used for joining the sides of sword mats together.

Take a filling of roping twine, middle it, and reeve each end through two bights in each mat (if a heavy mat, through three bights at each edge), then reeve the lowermost end back through the same bights as the upper end, which will bring the ends out at opposite sides, draw the mats together, and reeve both ends through two turns in each mat again, passing each other through the same hole opposite ways; and so work on, like stitching the sole of a boot on; hence the reason for calling it a cobbler's stitch.

Finish off each end by taking a hitch through a bight in the mat of the next lay above, and cut the ends off.



A Thrum Mat is made of canvas, and short yarns of equal length. These yarns are rove through holes stabbed in the canvas, both ends of the yarns being on the same side.

Common sennit is made by taking three or four foxes, according to the size you intend to make it, middle them over a belaying-pin and plait three or four of them together, the length you intend to make the eye, then work both parts together to form an eye, and plait them by bringing the outside foxes on each side alternately over to the middle; the outside one is laid with the right hand, and the remainder held firmly with the left hand; work the whole together, adding a fox when necessary;

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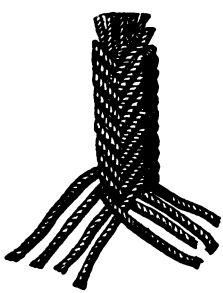
after the eye is properly formed, and you have worked 3 or 4 inches down, drop a fox or yarn, and continue to the end with an odd number. When it is a sufficient length, lessen it by dropping a fox at regular intervals. To finish it, lay one end up, leaving its bight down, plait the others through this bight, until they are all worked through it, then haul on the end till the bight is taut; to secure all parts, cut the ends off, and whip it.

Square Sennit.

Is made somewhat in the same manner as round sennit, but without a heart. Nettles are used in the same ratio, increasing by fours, but are worked singly instead of in pairs. Having put a whipping round the (eight) ends, divide the nettles, and lay half on each side, bring the uppermost left-hand nettle round underneath all, and up inside two and over two of the right-handed ones; crossing over the latter ones to the left and making four on each side again, then take the uppermost of the right-hand nettles, pass it underneath, and under two, and over two of the left-handed ones, still keeping four on a side, because the nettle taken up always comes round to its own side again. To proceed, take the upper nettle on each side alternately, and finish off as you finish round sennit.



To make a Pudding Fender.

Get your rope, already marked on a stretch, and worm it; the marks where the puddings are to be formed are filled up with any old stuff, such as old strands, spunyarn, &c.; in forming it take care the sides intended to be next the boat are flat, and the outer sides a half-round, the largest part is in the middle, tapering gradually off at both ends. When it is formed to the required shape, parcel it with strips of canvas and marl it down, beginning in the middle and marling both ways to the ends. It is

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then either grafted over or covered with leather. When fitted as a single fender, for any purpose, an eye is worked in each end.

SAILMAKING.

The materials used for sailmaking are—

Seaming palm } For protection to the hand and for
Roping ,, } forcing the needle through rope or canvas.

Needles.—Seaming and roping of different sizes.
Hook for securing canvas whilst being sewn, &c.
Rubber for rubbing out seams, &c.
Pricker for making holes in the canvas for eyelets.
Fid (a wooden marline-spike), used in the same way as a marline-spike.
Knife for cutting canvas, &c.

The different kind of seams used are—

Round seam for joining two cloths together.
Flat seam for tabling two cloths together.
Middle seam where extra strength is required.
Single last is a single round seam for joining or butting two ends together, after turning in the raw edges and forming a bight on each. Double last is a double round seam for the same purpose.
Selvage is the edge of a cloth of canvas.

Round Seam.

To sew a round seam you rub down one selvage according to the width of the seam required, place the other selvage to the bight and sew towards the hook, keeping the selvage towards you, putting about 112 stitches to the yard, rubbing down from the hook against the sewing.

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Middle Seam.

To sew a middle seam you commence from the hook with the canvas flat on the knees, putting from 70 to 80 stitches in a yard. (This is called "sticking.")

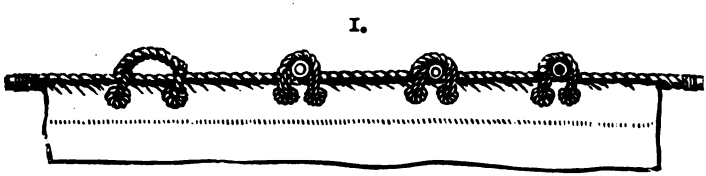
To Work an Eyelet-Hole.

Place your grommet on top, and commence sewing at that part of the hole farthest from you, sticking the needle down through outside of the grommet and up through the centre of the hole, working from left to right, taking care that the grommet is well covered.

To Make a Cringle.

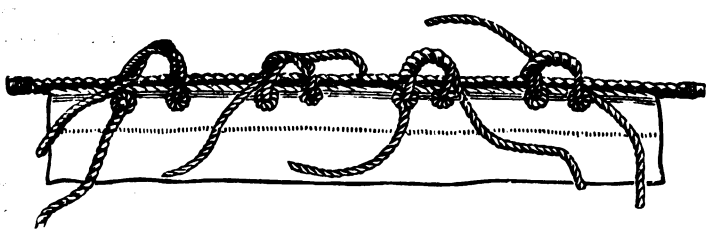
Unlay a single strand from the size rope your cringle is required to be, whip both ends, reeve the strand through the left-hand eyelet-hole in the sail, having one end longer than the other, nearly a third, keeping the roping of the sail towards you. If a thimble is to be put in the cringle, lay up the two parts of the strand together, counting three lays; commence with the short end of the strands towards you, then reeve the long strand from you, through

1.



the right-hand eyelet-hole, taking it through the cringle, and it will be in the right position to lay up in the vacant space left in the cringle; when done, the one end will hang down inside the right-hand eyelet-hole, and

2.



the other end outside the left-hand one, the ends are then hitched by being rove through their respective eyelet-holes, and passed over the leech rope, and under their

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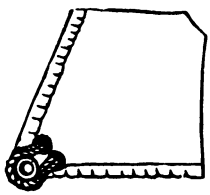
own part, one hitch being towards you, and the other from you, then take the ends down under one strand on the right, and two on the left of cringle nearest to it, then tuck the ends under the first two strands nearest the hitch, leaving them well in place; the cringle is then fidded out, and the thimble is put in on the fore part of the sail. The ends of the strands are then tucked back, left-handed, under one strand, again under two, right-handed, as in the first place, heaving them taut in place at each tuck, the ends are then whipped with two of their own yarns, and cut off. If a large cringle is needed, count an extra number of lays 5, 7, 9, &c., always an odd number.

To finish a Cringle off on the Crown.

Commence as before, after laying up the strand together instead of forming a hitch with each end, the ends are rove through their respective eyelet-holes, and tucked back under two strands of the cringles, and again laid up as far as the crown, forming a four-stranded cringle, and is finished off by tucking the ends under two strands, and crossing them under the crown of the cringle, and cut close off. Head cringles of jibs and staysails are made this way.

3.



Another plan of finishing a cringle on the crown is, instead of laying the strands up to make a four-stranded cringle, it is made like the first, as far as the hitch. After forming the hitch, as in the first plan, instead of tucking the strand under the two nearest strands of the leech-rope, it is backed and tucked left-handed under the nearest strand to it in the cringle, then right-handed under the strand towards the crown, both ends being served the same way, the cringle is fidded out, the thimble put in place, the ends cut off close.

N.B.—Thimbles are always entered in the cringles on the canvas side of the leech-rope; if entered on the rope side they are liable to take the edge of the canvas when being forced in place.

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In working a cringle in a piece of rope, such as the roping of an awning, where there are no eyelet-holes, the strand is tucked under two strands of the rope it is to be worked in, instead of being worked through an eyelet-hole. The ends are not hitched, but passed away in the rope, the ends being tucked back, left-handed, under one strand, again under two, right-handed, as in the first place, heaving them taut in place at each tuck, the ends are then whipped with two of their own yarns, and cut off. If a large cringle is needed, count an extra number of lays 5, 7, 9, &c., always an odd number.

To put a Bottom in a Bag.

Rub down about 1 inch on the bag, and the raw edge of the bottom, and sew towards the hook with the bottom towards you, then turn the bag and table down on the inside.

Tabling.

Tabling is sewing from the hook with the canvas flat on your knees, putting 70 to 80 stitches in a yard.

The "tabling" of a sail is the double part of canvas around the edges of the sail, and in which the eyelet-holes are worked.

Darning.

Is the process of mending a small hole in a sail without putting a patch in.

CANVAS.

Canvas is supplied in "bolts," and each bolt contains from 39 to 40 yards of material.

Various Classes of Canvas at present used in H.M. Service.

Designation.	Tensile Test.		Weight.
	Weft.	Warp.	
	Lbs.	Lbs.	
No. 1 Royal Navy Canvas –	480	340	46 lbs. per 39 yards
No. 2 ,, ,, ,, –	460	320	43 ,, ,,
No. 4 ,, ,, ,, –	400	380	36 ,, ,,
No. 6 ,, ,, ,, –	350	250	30 ,, ,,
No. 7 ,, ,, ,, –	390	330	27 lbs. per 40 yards
No. 4 Merchant Navy Canvas	240	170	35 lbs. per 39 yards
No. 6 ,, ,, ,,	210	150	30 ,, ,,

The tensile test is carried out on strips 2 feet long and 1 inch wide for Nos. 1, 2, 4, and 6, and on strips 1½ inches wide for No. 7.

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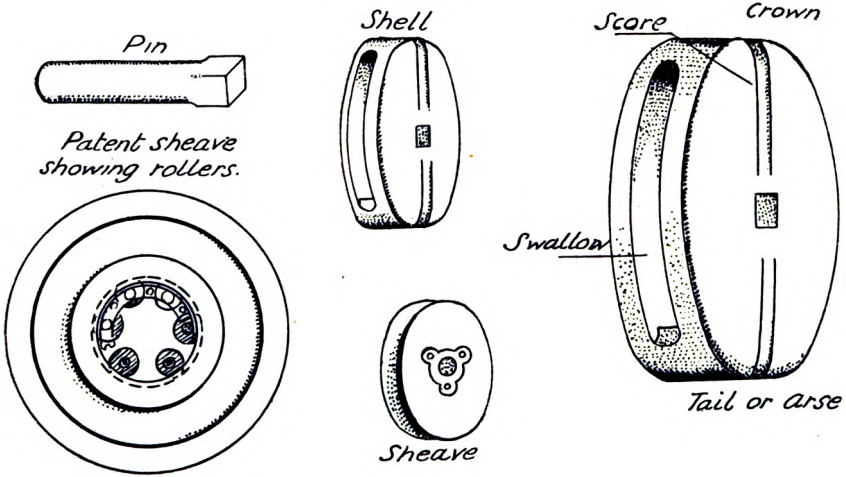
Parts of a Block.



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Formerly both wide (24 inches) and narrow (18 inches) canvas was used in H.M. Service, but at present only that 24 inches wide is used.

For Ship's sails, courses are made of No. 4, spankers of No. 4 or 6, jibs, No. 6, flying jibs, Nos. 6 or 7, royals, No. 7, gaff-topsails, Nos. 6 or 7.

Boats' sails are made of :—

Single-banked boats :—cotton duck.

Double-banked boats :—No. 6 canvas.

BLOCKS AND PURCHASES.

Parts of a Block.

Shell.—The outside case of a block.

Sheave or Shiver.—The wheel on which the rope travels. It is made of metal (generally phosphor bronze), lignum vitæ, or iron.

Roller Sheave is fitted with a metal bush and metal rollers working round the pin.

Bush.—In a lignum vitæ or iron sheave, the centre hole through which the pin passes, is fitted with a metal bearing or bush.

Pin, is made of steel, has a head at one end, and passes through the centre of the shell and bush of the sheave.

Score.—The groove on the outside part of the shell to take the strop; a block is either single or double scored.

Crown is the top of the block, and has not such a deep score as the bottom.

Tail or **Arse** is the bottom of the block, and is easily known by the deep score it has to receive the splice of the strop.

Swallow is the open part between the sheave and the shell.

There are various kinds of blocks used, as follows :—

Block.	Material.	Use.
Common Block.	Wood fitted with wire strop.	Small taekles and general use, either double or single.

Internal Iron-bound Blocks are built blocks having an iron strop inside the shell; the pin of the sheave working on the iron strop inside the shell is much stronger, besides

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having the great advantage that the shell, if broken, can be replaced on board. There are various sizes used, from 5 inches and above, but two patterns only are made "with becket" or "without."

Iron Blocks are of the following kinds :—

M.C.I. (*malleable cast-iron*) *Blocks* are either single, double, or treble iron blocks with metal sheaves, used for general use (Fig. 1).

Gin Blocks.—Iron blocks with metal sheave, supplied for coaling whips (Fig. 3).

Clump Blocks may be made of wood with wire strop, internal bound, or iron.

They are short thick blocks, and will take a rope one-half its size.

Snatch Block is an iron-bound block with the shell cut away immediately over the swallow, to allow any part of the rope to be lifted in or out of the block without putting its end through first. The iron strop over the swallow is fitted with a hinge which must be clamped and pinned before use (Fig. 2).

Swivel Blocks are iron-bound blocks with a swivel either in the crown or the hook.

Blocks are measured for size along the score from the crown to the tail.

STROPPING BLOCKS.

All blocks are stropped with wire rope.

The two kinds of strop in use are single and double.

Single Strop.

Measurement.—Three times round the block, ditto round the thimble, and ditto round the rope, will give the length of the strand required to make a grommet for a single strop.

To make the Strop.—Make an ordinary wire grommet, worm, parcel, and serve it, place it round the score of the block, introduce thimble, and seize the grommet between the crown of the block and thimble with a round seizing of hemp.

Double Strop.—Make an ordinary wire grommet twice the size of a single strop for that block; worm, parcel, and serve. Place the two bights round the two scores of the block, introduce thimble and seize both parts with a throat seizing between thimble and crown of block.

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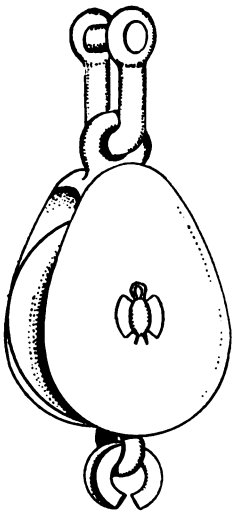

Fig 1

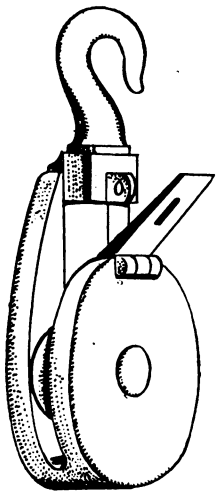

Fig 2

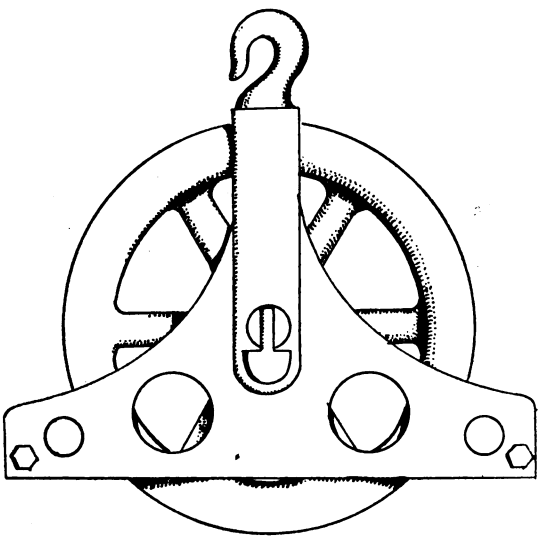

Fig 3.

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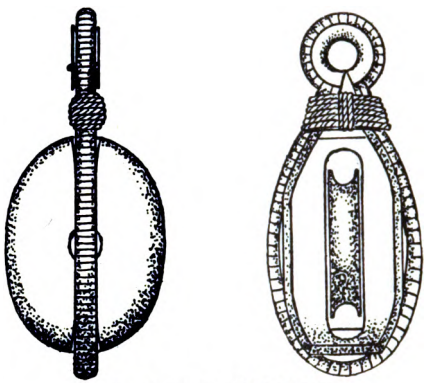
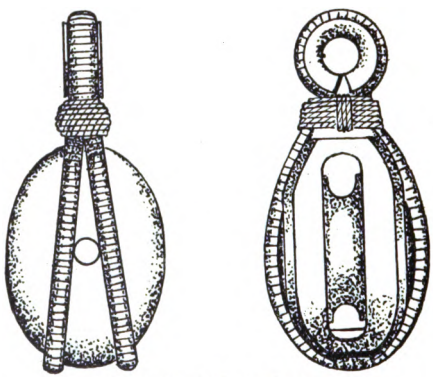


SINGLE STROP



DOUBLE STROP

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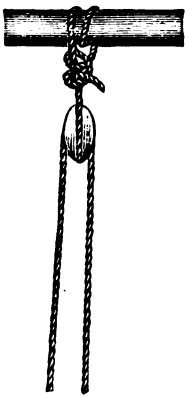
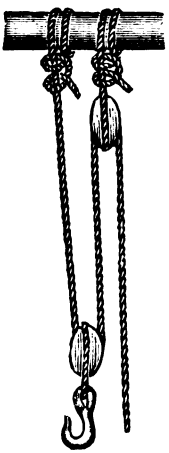
PURCHASES.

Single Whip.—A rope rove through a single block fixed in any position. No power is gained. Used for all light work.



Double Whip.

Double Whip.—A rope rove through two single blocks —upper block a tail block, lower one a movable hook block, the standing part of the fall secured close to the tail block. Power gained—double. Used for all common purposes where a single whip has not enough purchase.



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Runner.

Is a piece of rope rove through a single block with a standing eye in one end and pointed at the other. Power gained—double. Generally used in connection with another purchase.

Spanish Burton.

A Single Spanish Burton.—Two single blocks and a hook. Power gained—three times. Is not very generally used.

Luff.

Two hook blocks, one double and one single. The standing part of the fall of this tackle is spliced into the strop at the arse of the single block; it is sometimes rove through a becket in the arse of the single block and secured by being spliced round the strop at the neck of it. Power gained—three or four times, according as to which is the

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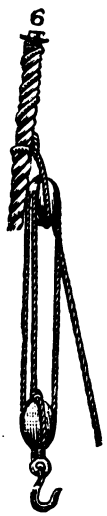
movable block. Used for all common purposes where a heavy pull is required.

Jigger.

A small tackle for general use; a double block with a tail, called a tail jigger, and single block with a hook. Power gained—three or four times, according as to which is the movable block. It is also fitted with two hook blocks, one double and one single. The standing part of the fall being spliced into the strop of the single block at the arse.



Handy Billy

A small tackle for general use.

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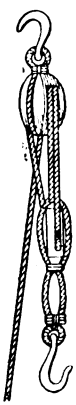
Up-and-Down Tackle.

A double and single block; the double block is fitted with a thimble, the single block is a hook block, fitted with a long strop. Standing part of fall is spliced in the strop of the single block. Power gained—three times.

Burton.

A double hook block and a single hook block, fitted with a long strop, the standing part being spliced round the strop and hook of the single block. Power gained—three times. Used for purposes too heavy for whips.



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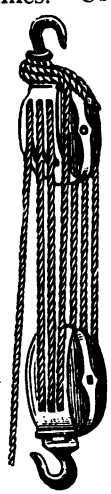
Runner and Tackle.

Consists of three blocks, one double and two single. One of the single blocks is fitted with a thimble, as a lashing or shackling block, through which the runner is rove. The double block of the tackle is turned in one end of the runner; the standing part of the tackle is spliced in the seat of the single block, which is fitted with a long strop and a hook. Power gained—eight times. Used for shrouds of a launch's mast, compressor tackles, raising sheer legs, &c.

Three-fold Purchase.

Three-fold Purchase.—Two three-fold blocks. Power gained—six or seven times. Used for catting anchor by hand.



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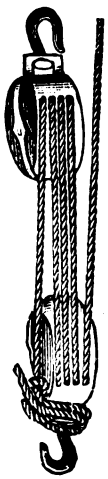
Four-fold Purchase.

Four-fold Purchase.—Two four-fold blocks. Power gained—eight or nine times. Generally rove through metal blocks, or wooden-built blocks. Used where any heavy purchase is required.



Effect of Friction on the Power Gained.

In the foregoing descriptions the power gained is calculated on the basis that there is no friction, and that the rope is absolutely flexible. In actual practice the power gained is much less than that given. Friction alone on a half turn around a sheave causes the force on the hauling part of the rope to be from 5 to 10 per cent. greater than on the other side.

Differential Blocks or Weston's Patent Blocks.

These blocks are supplied for use in lifting portions of machinery, torpedoes, gun-mountings, &c. when undergoing examination, and are usually termed "Weston's Blocks."

They consist of an upper block containing a double sheave (in one piece) and a lower block with a single sheave; both blocks are fitted with a hook.

The outer edges of the top sheave are grooved, that is, they have spaces provided for receiving each link of the chain, which spaces correspond with the pitch of the chain, and are very accurate in every detail. Guide pieces

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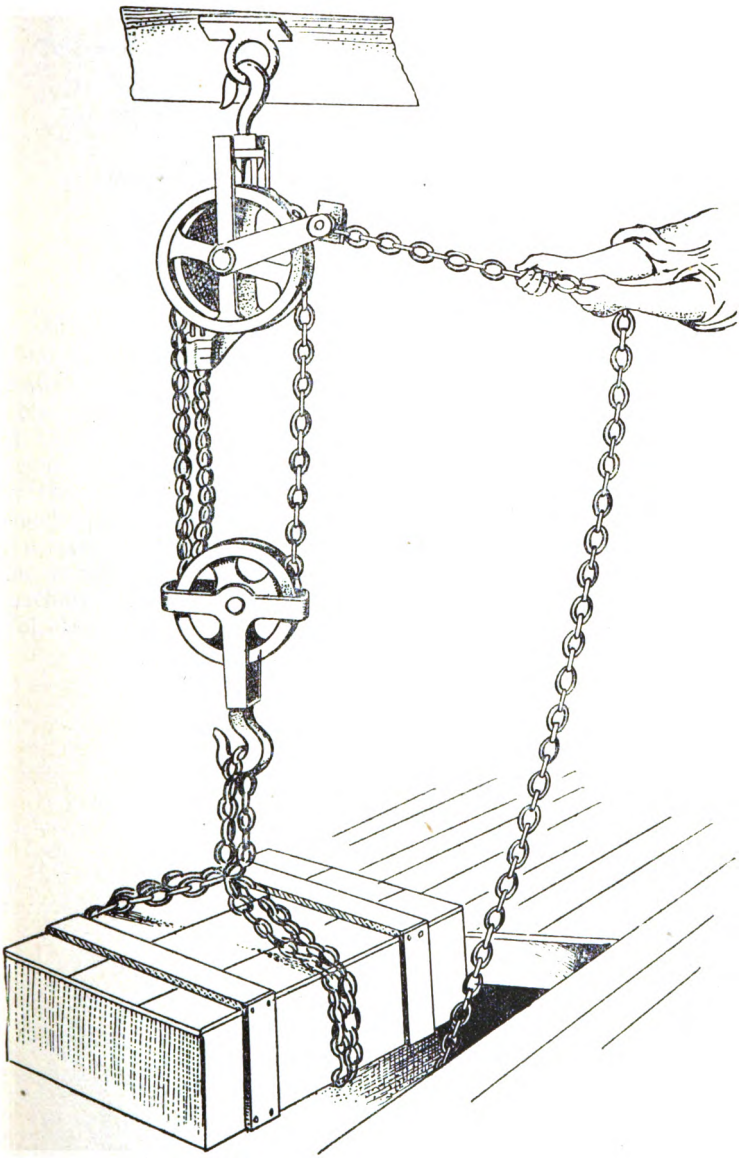
WESTON PURCHASE.



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are attached to each side of the upper block to insure that the chain does not work off the block when being worked.

The most common sized blocks in use in the Service are those capable of lifting one ton, being worked at 75 per cent. of their tested strain.

To reeve the chain :—

(1) Remove the pulleys.

(2) Place one bight of the chain in lower pulley and connect.

(3) Make a round turn with the other bight of the chain and place each side on the corresponding sheave of the upper block and connect up, taking care to replace the split pins and open the ends of same.

A peculiarity common to these blocks is that when a weight is suspended they will remain in any desired position without any tendency to overhaul themselves. This is brought about by the difference in the diameters of the pitch spaces and number of links engaged, there being (in the upper block) 18 in the raising side and 17 in the lowering side of the chain. As the lifting chain which passes over the larger pulley is raised 18 links, the other part of the lifting chain is lowered 17 links, the result being that the weight is raised half a link, the mechanical advantage in this case being 35 to 1. (*See* Vol. II.)

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CHAPTER IV.

METHODS OF SOUNDING.

HAND LEAD AND LINE.

The weight of the hand lead is from 10 to 14 lbs., and is fitted with a hide becket, which is secured to the lead, the bottom of the lead being hollowed out to receive the "arming" (filled with tallow), to ascertain the nature of the bottom.

The line is of $1\frac{1}{8}$ inch, and is 25 fathoms in length; it is bent to the lead line by running a long eye splice made at the end of the line, through the hide becket on the head of the lead, and then passing the lead through the eye.

The lead line is marked as follows:—

At	2	fathoms	– Two strips of leather.
,,	3	,,	– Three ,, ,,
,,	5	,,	– A piece of white bunting.
,,	7	,,	– ,, red ,,
,,	10	,,	– A piece of leather with a hole in it.
,,	13	,,	– A piece of blue bunting.
,,	15	,,	– ,, white ,,
,,	17	,,	– ,, red ,,
,,	20	,,	– Two knots.

Sounding Lead.

(*Note.*—The line reeves through the slits in ends of bucket.)

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When using a longer line than 25 fathoms the line is marked similarly to the deep-sea lead line.

The fathoms at 1, 4, 6, 8, 9, 11, 12, 14, 16, 18, 19 are not marked, and are called "deeps."

To Heave the Lead.—Ships are generally fitted with a platform on each side of the forecastle, which is called the "chains." (In older ships the platform was on either side of the forebridge.)

The leadsman, on going into the chains, should :—

(1) Remove his knife and lanyard.
(2) See the breast rope and apron properly secured.
(3) See the end of the lead line is made fast.
(4) That the becket is in good condition.
(5) That the line is clear.

The lead is always hove in the direction that the ship is moving.

Ease the lead down towards the water until the amount of scope is out, *i.e.*, the distance from the lead to the hand, generally 2 to $2\frac{1}{2}$ fathoms, then hold the line with a round turn round the hand, and the coil in the other hand, keep the body upright, face slightly in the direction the ship is moving, and rest against the breast rope, swing the lead as an ordinary pendulum, to obtain impetus, then swing it over the head in a circle by bending the arm smartly in at the elbow as the lead is rising and letting the arm go out again after the lead has passed the perpendicular; after completing two or three circles slip the line after the lead has passed the water and before it comes to the horizontal easing the coil out from the other hand; when it has run out as far as it is going, gather in the line with both hands, and obtain an up and down sounding as the ship passes the lead.

To Haul in the Line.—The line is always hauled in with the right hand under and the left hand over, so as to make a right-handed coil and prevent its kinking.

Calling Soundings.—If the depth of water obtained corresponds with any of the marks on the line, the leadsman calls "By the mark 5," "By the mark 7," &c.; if it corresponds with what he judges to be a deep, he calls "deep 6," "deep 8," &c. If a quarter or half a fathom more than a mark or a deep, he calls "and a quarter 7," "and a quarter 8," &c., or "and a half 7," "and a half 8," &c. If a quarter of a fathom less than a mark or a deep, then he calls "and a quarter less 7," or "and a quarter less 8," &c.

Care should be taken on no account to over-estimate the depth of water, and it is customary to call a quarter of a fathom less than the actual soundings.

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The depth of the water in daylight is seen by where the water cuts the lead line when the lead is at the bottom and directly under the leadsman; but after dark, by deducting from the nearest mark to the hand the distance from the breast rope to the water's edge. This distance is called the drift.

When soundings are required at very short intervals, a second man is generally placed in the chains to assist in hauling in the line.

The lead should always be kept on the bottom when a ship is getting under way, and the leadman should report directly the ship moves either ahead or astern.

Deep Sea Lead and Line.

In the event of failure of the sounding machines supplied, the deep sea lead and line forms the only safeguard. The lead weighs from 28 to 30 lbs., and is hollowed at the bottom for the purpose of being "armed."

The line is 100 fathoms long, and is marked the same as a hand line up to 20 fathoms, and then at each five fathoms with one knot, and at 30, 40, 50, &c., with three, four, five, &c., knots respectively.

In sounding with the deep sea lead, the ship is "stopped," the lead line is carried forward on the weather side, outside everything, from quarter to the forecastle, where it is bent to the lead, a number of men are stationed to hold the line clear of the ship's side, and to take the sounding, in case the lead reaches the bottom sooner than is expected; they each have a small coil of line in their hands, so as not to check the lead as it is going down. The quantity of line to be hauled off the reel and passed forward depends upon the supposed depth of water.

The lead is hove overboard forward, and as each man attending the line feels it tauten, and is sure the lead has not reached the bottom, he flings his coil overboard, passing the word to the next man aft, by saying "Watch there, watch!" If it has not reached the bottom before, the sounding is taken by the Quartermaster, on the weather quarter, with the line as nearly up and down as possible.

Lead lines should be measured when wet, and marked from the bottom of the lead.

Boat Lead and Line.

The weight of the lead is 7 lbs., and is of leg-of-mutton shape. The line is generally made of 2½-lb. line, and about 10 to 12 fathoms long, marked in feet up to 3 or 4 fathoms, after which in fathoms, in the same way as the hand lead.

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SOUNDING MACHINES.

The type of Sounding Machine at present in general use in the Royal Navy is the "Kelvin Mark IV."

With this machine soundings can be obtained with great rapidity and without checking the speed of the ship.

The "Kelvin Mark IV." Sounding Machine.

Description of the Kelvin Mark IV. Machine.

The metal frame, which is firm and strong, is bolted to the deck, and supports in a shaft bush a horizontal shaft or spindle, which passes through the sprocket wheel, brake cheeks and the drum. This spindle is true, except for a small portion which is threaded, on which threaded portion the right brake cheek and the sprocket wheel work. The drum is free to revolve on the true portion of the spindle, unless held by the brake cheeks.

The frictional brake is actuated by means of having one brake cheek keyed to the spindle and the other working on the threaded portion of the spindle, this latter brake cheek being attached to a sprocket wheel which may be prevented from rotating by a catch pin at the side of the machine.

The drum is fitted with a lignum vitæ bush, and takes 300 fathoms of seven-strand wire, the inboard end of which is secured through two small holes, and back around its own part.

To the outward end of the wire is secured, by means of a hemp line, a specially-constructed lead, with an iron shank, weighing about 24 lbs.

There should be 9 feet of hemp line between the eye of the shank and the end of the wire. On this hemp line, and 3 feet from the eye of the shank, is lashed a brass guard-tube, in which is placed the glass chemical tube. The brass guard tube has a removable cap, with a bayonet joint on one end, and small holes to admit the water bored in the other end. The end with the holes should be nearest the lead. On the left side of the drum, clear of the brake cheek, is a gunmetal V-shaped groove, over which the automatic brake cord works, the ends of the cord being secured to weights in the tubes. The weight at the back of the machine should be 6 lbs., and resting on the bottom of the tube; the weight at the front being only 1 lb., and suspended 1½ inches from the bottom of the tube. At high speeds, say 13 knots, this 6 lb. weight must be increased. Four 1 lb. weights are supplied for this purpose.

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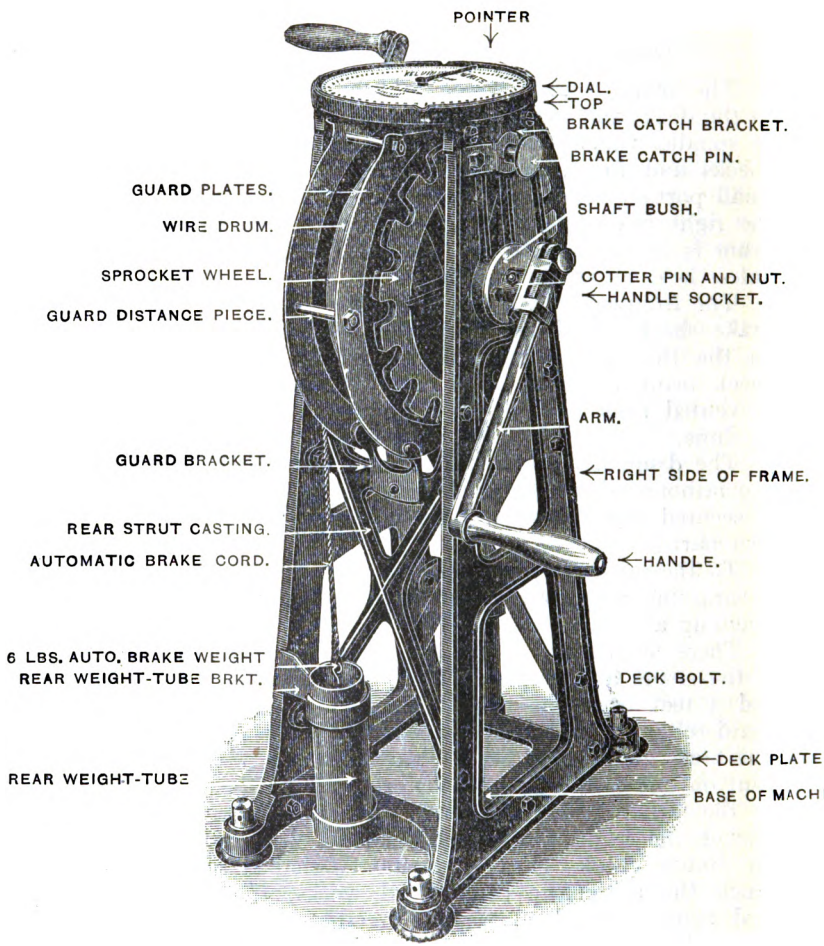
RIGHT-HAND SIDE OF MACHINE.



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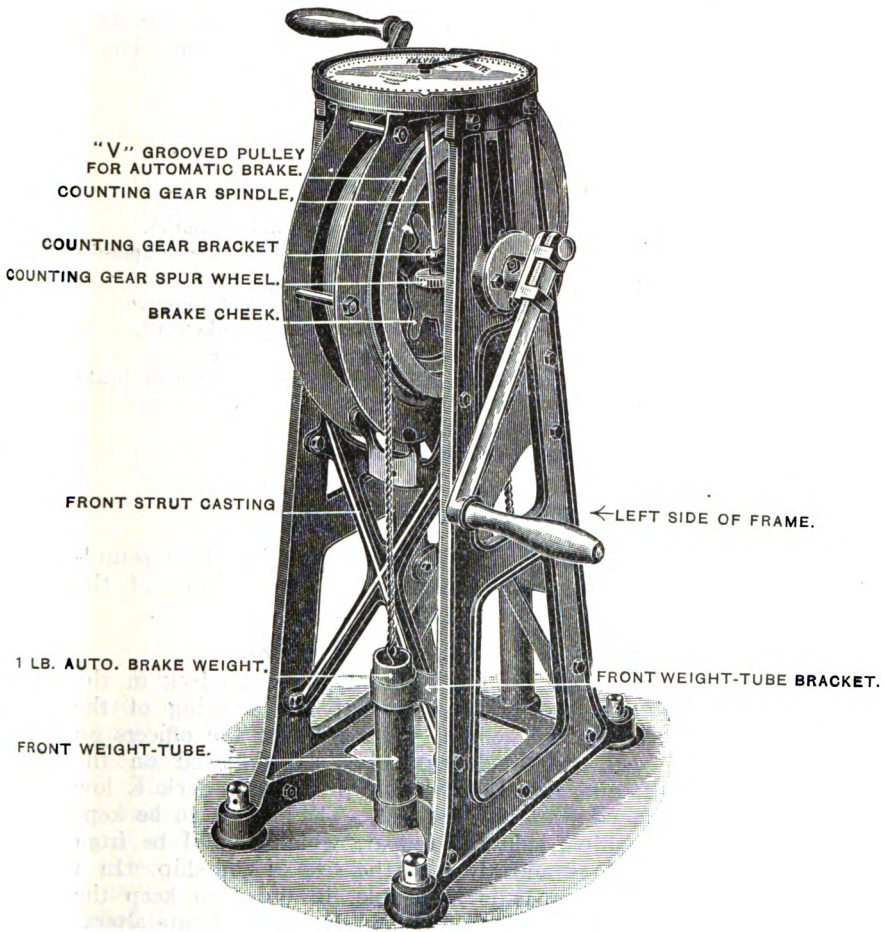
LEFT-HAND SIDE OF MACHINE.



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It is important that only the proper brake cord be used. Spare brake cords are supplied in suitable lengths.

The automatic brake ensures uniformity in the running of the machine, when the ship is also steaming at a uniform speed, provided certain points are attended to, which will be mentioned later. On the lop of the machine is a dial, which, actuated from the drum by a worm and cog-wheels, will show the number of fathoms of wire out at any moment, and is so graduated as to allow for the decrease in the working surface of the drum as the wire runs out. At the sides are the handles which are secured in place by small bolts.

PLATE A.

a = wooden surface of left brake cheek.
b = ,, ,, right ,,
c = left brake cheek.
d = right ,, (working on threaded portion of spindle).
e = spindle. *f* = threaded portion of spindle.
g = sprocket wheel. *h* = catch pin.
j = sprocket which takes catch pin. *l* = V-shaped metal groove.
m = position for cord in groove. *n* = automatic brake cord.
r = dial. *s* = top of machine.
z = spring to keep drum clear of left brake cheek when main brake is off.
s' = worm and cog for working dial. *z'* = pointer.
o' = tube for weights for automatic brake.

METHOD OF SOUNDING.

The " Kelvin Mark IV." is specially designed for sounding from forward, either from or in the vicinity of the navigating bridge.

To take Soundings from Forward.

The machine should be fixed on the spar deck in the vicinity of the fore bridge, so that the working of the machine is under the general supervision of the officers on the bridge. If space admits, it may be placed on the bridge itself, and this is advisable if the spar-deck is low and liable to be swept by the sea. The wire is to be kept clear of the ship's side by a spar, which should be from 30 to 40 feet long according to the size of the ship. In a long ship a long spar is advisable, in order to keep the sounding wire clear of the propellers during moderate alterations of course.

The spar should not be over 5½ inches in diameter, and the heel may be fitted as convenient, but must admit of spar being guyed either forward or aft, and topped up or lowered down. A topping lift and guys must be fitted, also

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an outhaul for carrier and block. The wire itself serves as an inhaul, and must work as nearly as possible parallel to the spar.

The spar should always be in position at sea, and the hide lacings of the carrier should be kept greased and not allowed to become dry and hard.

The connection between the hemp and the wire should be a swivel, to prevent turns passing into the wire when the lead is struck by the top of a wave and set spinning, as sometimes happens.

"*The Automatic Brake*" prevents the iron drum over-running, and ensures that the resistance against the wire, when running out, is always constant for all speeds of the ship. This causes the length of the wire run out for the same speed of the ship to be the same for the same depth, provided that the following points are attended to :—

(*a*) That when releasing the main brake, at the order "let go" it is given *one complete turn* in the contrary direction to "heaving in" on the handles, this must be done smartly. *Note.*—The brake having previously been eased.

It is important to ease the brake exactly the same amount for each cast.

(*b*) That sinkers of the same shape and of exactly the same weight are always used.

(*c*) That the same length and size of stray line is always used, that the swivels are identical, and that the guard tube is seized on in the same place.

(*d*) That the same brake weight is in use ; because at a given speed a 10-lb. weight would not permit the wire to run out with as much velocity as the 6-lb. weight.

(*b*), (*c*), and (*d*) will generally remain constant for any series of soundings, but (*a*) in the hands of a careless man may easily vary with every cast. (*a*) is therefore by far the most important precaution.

The following method should always be adopted to obtain a uniform release of the brake :—Firstly, ease back the brake handle very carefully until the wire is seen to "creep" off the drum. Then, noting the exact position of the brake handle, give *one complete turn* in the opposite direction to "heaving in," bringing the handle back to exactly the same position as was noted.

This property of constant resistance against the wire running out for all speeds is a most valuable feature of the Mark IV. machine. It enables a far more accurate indication of the vertical depth to be given when not using

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tubes, or only using them occasionally, than was possible with the older machines. When soundings are being taken continuously, and the ship is steaming at a constant speed, a change of depth is at once indicated by a less or greater amount of wire out.

Steaming in 20 fathoms of water at a speed of 10 knots, soundings can be easily obtained continuously once a minute, and in 10 fathoms once every half minute.

It is important that the number of fathoms of wire run out should be noted at the instant the wire slacks, and not after the brake has been applied, as a few fathoms of wire may run out during the operation of applying the brake.

To make ready for a cast.—Have the sinker and the stray line attached to the swivel in the usual manner. Insert a chemical tube in the brass guard, sealed end up. Ship the handles and let the wire off gently, so that the leadsman may put the wire through the block, then run the block carrier out by the outhaul, and belay it. Now, by the handles, let the sinker down until it is almost touching the water. Push home the brake catch, set the pointer on the dial to zero, and call "Ready."

To "let go."—Turn the handle one turn in the direction in which the wire runs out. Press the feeler gently on the wire. Immediately the wire slackens, showing that the sinker has touched the bottom, call out the number of fathoms on the counter, and turn the handles one turn in the winding-in direction, withdraw the brake catch and wind in until the sinker is again clear of the water. Push home the brake catch pin and set the pointer to zero, calling "Ready."

If sounding with tubes, when the lead is clear of the water, ease the outhaul and heave in slowly until the carrier has reached the heel of the boom. Then push home the brake catch pin.

Take the chemical tube out of the brass guard, and keeping it vertical with sealed end up, apply to boxwood scale. The reading abreast the lowest part of the red coating gives the depth of water.

When a Sounding Tube is properly used the cut is perfectly definite and unmistakable. The principal causes of bad cuts are as follows:—

(1) Allowing the line to over-run after the sinker has touched bottom. Should a considerable amount of over-run be permitted, the sheath containing the Sounding Tube may lie horizontally on the sea bed, which will probably result in a bad cut.

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The sheath is usually fixed about a fathom's length above the sinker, so that a margin is allowed to over-run. This is found sufficient with careful handling.

(2) Too sudden an application of the Sounding Machine Brakes. If the running out of the line be stopped with a violent jerk the weight of the sinker at the end of a long flexible line of steel wire is likely to set up an oscillation causing the water inside the Sounding Tubes to jump and the cut to be erratic. The brake of the Sounding Machine should be applied by means of the handle *gradually and evenly*, not jerkily. With a small amount of experience this is very readily achieved.

(3) After winding in the sinker allowing the sheath containing the tube to be laid down on deck horizontally before removal of the tube. In such case any drop of water which may remain in the tube is likely to run up the sides of the tube disfiguring the cut. The sheath and tube should be held vertically until the tube is removed and the depth read off on the fathom scale.

The following corrections must be applied if the barometer is above 29·50 :—

Barometer	29·75	add 1 fathom in		40.
,,	30·00	,,	,,	30.
,,	30·50	,,	,,	20.
,,	31·00	,,	,,	15.

The glass chemical tubes are coated inside with chloride of silver, which shows red, but is turned white by the action of the water.

Thus, the deeper the tube goes, the greater the pressure and the further the water is forced up the tube.

These chemical tubes are supplied in a wooden box containing 10 tin cylinders, each cylinder containing 10 tubes.

One hundred tubes are supplied with each machine, and it is absolutely essential that these tubes shall be stowed in a dry place, otherwise they will deteriorate.

The machine must be kept clean and well oiled.

When the machine is not in use, *the main brake must never be left set up.*

Detailed instructions for use and care of machine will be found in a printed pamphlet by Kelvin and James White.

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A "Sounding Book" is supplied in which all soundings obtained when using the machine should be entered.

There is also a depth recorder supplied sometimes with the sounding machines, which may be secured in the place of the brass guard tubes. This consists of an airtight cylinder with a piston working in it. The pressure of the water acting on the piston compresses the air in the cylinder, which is assisted in resisting the pressure of the water by two springs. By means of a graduated scale, and a pointer which is moved along it by the piston rod, the depth can be read off. This pointer must be reset each time before sounding.

Motor Sounding Machines.

Owing largely to the great increase in speed of modern steamships, both ships of war and ships belonging to the Mercantile Marine, sounding machines are now being made which are fitted with an electric motor for heaving in. With the modern fast ships, the labour required for heaving in the lead after a cast in moderately deep water is found to be excessive. It is impossible to put a sufficient number of men on the handles to heave in with the requisite rapidity. On the other hand, it is to be noticed that the quantity of wire which must be run out for a cast in given depth of water with a fast going ship is much greater than with a slower vessel. Hence the necessity for a motor-driven sounding machine.

The motor machine is practically Lord Kelvin's Mark IV. sounding machine with an electric motor applied for the purpose of winding in the wire; but with all the arrangements for heaving in by hand retained. All the provisions for obtaining a constant rate of egress of the wire, for a given speed of the ship, are maintained as before, and the wire runs out under the same conditions. Thus the instructions already given for the use of the Kelvin Mark IV. machine apply to the motor-driven machine; and it is only necessary to add a few remarks which are specially applicable to the use of the motor machine.

The motor is in a watertight casing; and, with the starting switch, forms the lower portion of the machine. It is constructed to suit the voltage of the circuit of the ship to which it is to be supplied.

The shaft of the motor passes vertically through the top of the casing, and has a raw hide bevel pinion of special design keyed to it.

The sprocket wheel of the Mark IV. machine has been replaced by a ratchet wheel. The teeth of this wheel engage a hardened steel ball, lying free in a small trough

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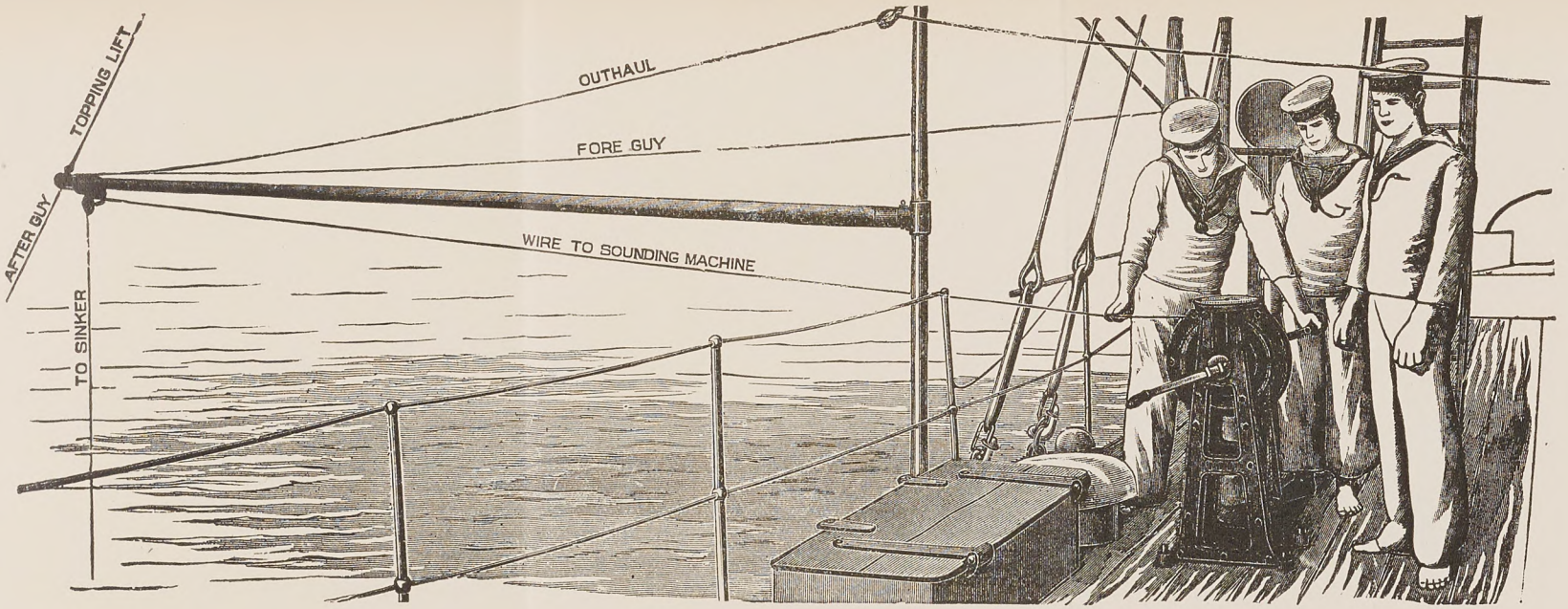
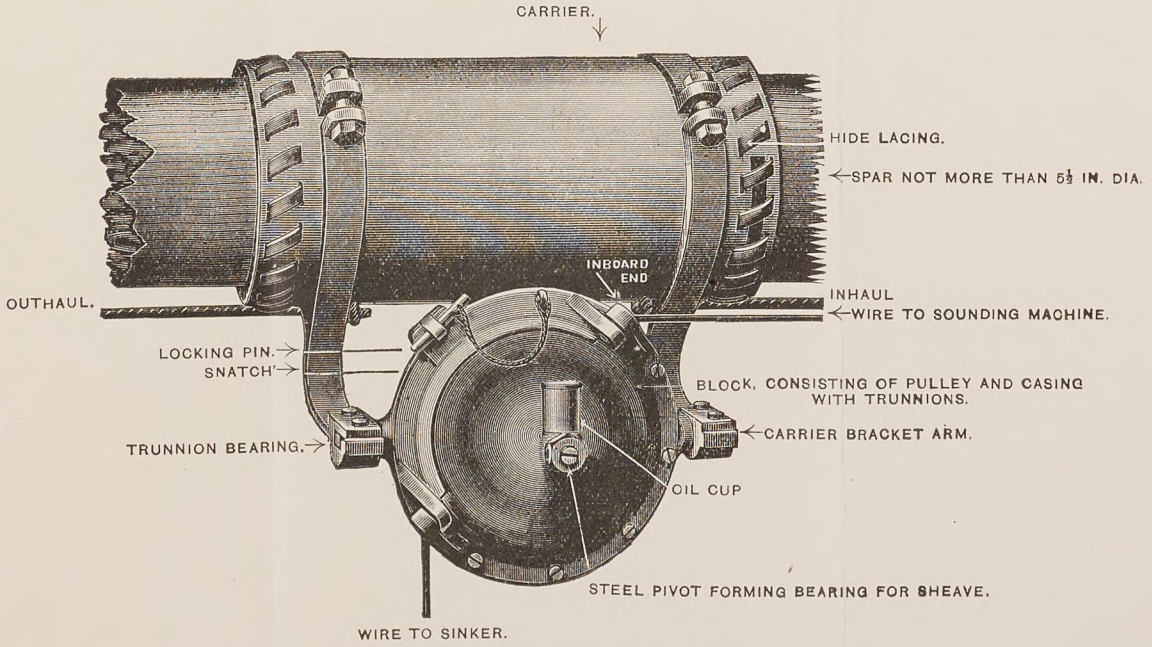


SOUNDING FROM THE FORE BRIDGE—WIRE RUNNING OUT.

NOTE.—The Carrier is shown in position for use on the PORT side of the ship. For use on the STARBOARD side of the ship it must be put the reverse way on the spar.

The concave side of the Carrier Bracket Arms will face AFT on the PORT side, and FORWARD on the STARBOARD side.



LARGE VIEW OF CARRIER AND BLOCK.

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fixed in the front strut casting of the upper framework. The bottom of this trough is an inclined plane, lying tangental to the ratchet wheel circumference, and arranged so that ball cannot escape when the ratchet wheel is at rest and no current passing through; the ball rolls to the lower part of the trough and locks the ratchet wheel, so that wheel cannot revolve in the direction contrary to that of heaving in.

When the ratchet wheel revolves in the direction of heaving in, on the application of current to the motor, the ball is drawn clear of the ratchet wheel teeth and held so, by an electro-magnet connected to the motor-circuit.

This ball and trough allows the brake catch of the Mark IV. to be dispensed with, and enables the main brake to be applied by the action of starting the motor.

There is a large bevel wheel keyed to the spindle on the right of the ratchet wheel. Its teeth engage those of the raw hide pinion on the motor shaft; and the power is thus transmitted from the motor to the spindle of the sounding machine.

On the left side of the machine a socket is provided on the end of the spindle, in order to ship a handle when it is desired to work the machine by hand. At the right side of the machine, there is provision for a handle on the outer edge of the large skeleton wheel which is keyed to the end of the spindle for operating the main brake.

The starting switch, fixed on the front of the motor casing underneath the wire drum, is provided with a spring-controlled handle which flies to the "off" position when the handle is let go. The speed of the motor is controlled by the position of the handle, giving the maximum speed when the handle is hard over to "on," and decreasing as the handle is brought back to "off."

The action of the machine is as follows:—

To take a sounding, the spar is got into position and the wire snatched in the block of the carrier, and the sinker got over the side, the wire being eased or checked by attending to the skeleton wheel, turning it *in the direction* of heaving in to *brake*, and in the contrary direction to *ease* the wire. The sinker being at the surface of the water, the brake should be put hard on and the pointer set to zero. The operator then puts the loop of the feeler pin over his right wrist.

To "let go" he holds the skeleton wheel with both hands, and gives it *one half turn only* in the direction contrary to that of heaving in, and the wire runs out (one spoke is painted white, which enables the amount of one turn to be easily seen, there are also stops on bevel wheel and brake wheel which lock when one complete turn has been given).

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He immediately takes his right hand off the wheel, puts the feeler pin on the wire, and presses gently, catching the handle of the starting switch by his left hand. As soon as the wire slackens, the motor switch is put over about half way, and then gradually put right over to the "on" position, to heave in at full speed. The motor starts and rotates the bevel wheels; the large one, being keyed to the spindle, turns it; and the screw thread on spindle runs the ratchet wheel and its beechwood cheek to the left, against the wire drum, pressing it against the left cheek, which is keyed to the spindle. Everything on the spindle is thus made solid with it, and turns together in the direction of heaving in.

The wire is guided on to the drum evenly by a man with a pad of oiled canvas. This can be done best by the operator of the motor, who, for this purpose, has now dropped the feeler pin from his right hand.

When the pointer shows 10 fathoms, the motor switch is eased back gradually; and motor is stopped before the swivel reaches the carrier block.

The brake is put on by starting the motor against the resistance of wire.

Sometimes when the switch is put to "off," the tooth of the ratchet wheel falls back on the steel ball with sufficient force to take the brake off, and the wire will start running out. This will necessitate switching on and "heaving in" again.

When the machine is used as a hand machine, and it is desired to put on the brake, the skeleton wheel should be given a very quick turn in the heaving-in direction.

The directions for the care of the machine are given in the latest edition of "Instructions for Lord Kelvin's "New Sounding Machines, Admiralty Pattern, Mark IV., "Hand driven only and Hand and Motor driven."

The bearings of the motor shaft are lubricated by Stauffer type grease lubricators fitted to top and bottom bearings on left hand side of machine. The grease cups should be given a turn occasionally, and a good quality of motor grease used for refilling.

To take up the backlash in the bevel wheels, and in order to be able to draw the motor out of gear when working the machine by hand, the upper framework of the machine is fastened to the motor casing by screws in elongated holes. By slacking off these screws, the upper part of machine may be moved sufficiently to disengage the bevel wheels.

It is most important that these screws should be kept tightly screwed up, and the top half of the machine in the correct position for motor working. If the screws work loose, the bevel wheels will not properly engage, and when

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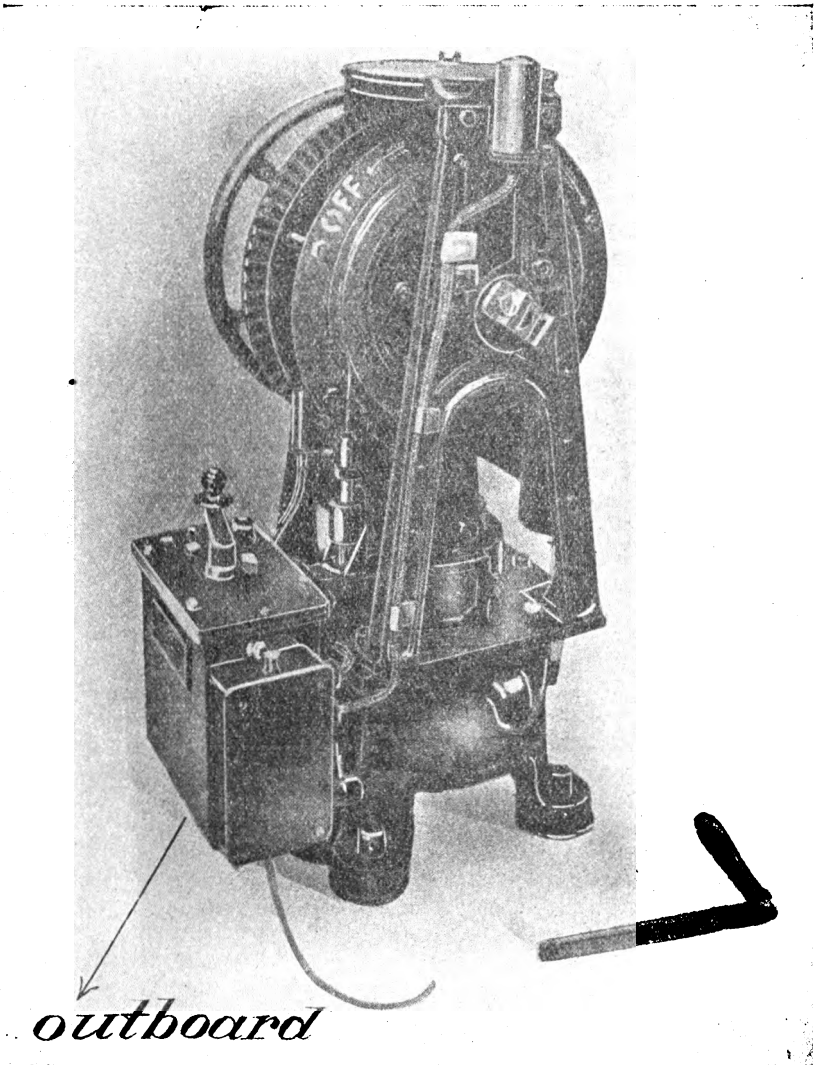

LORD KELVIN'S SOUNDING MACHINE.
Hand and Motor Driven. With all latest improvements.

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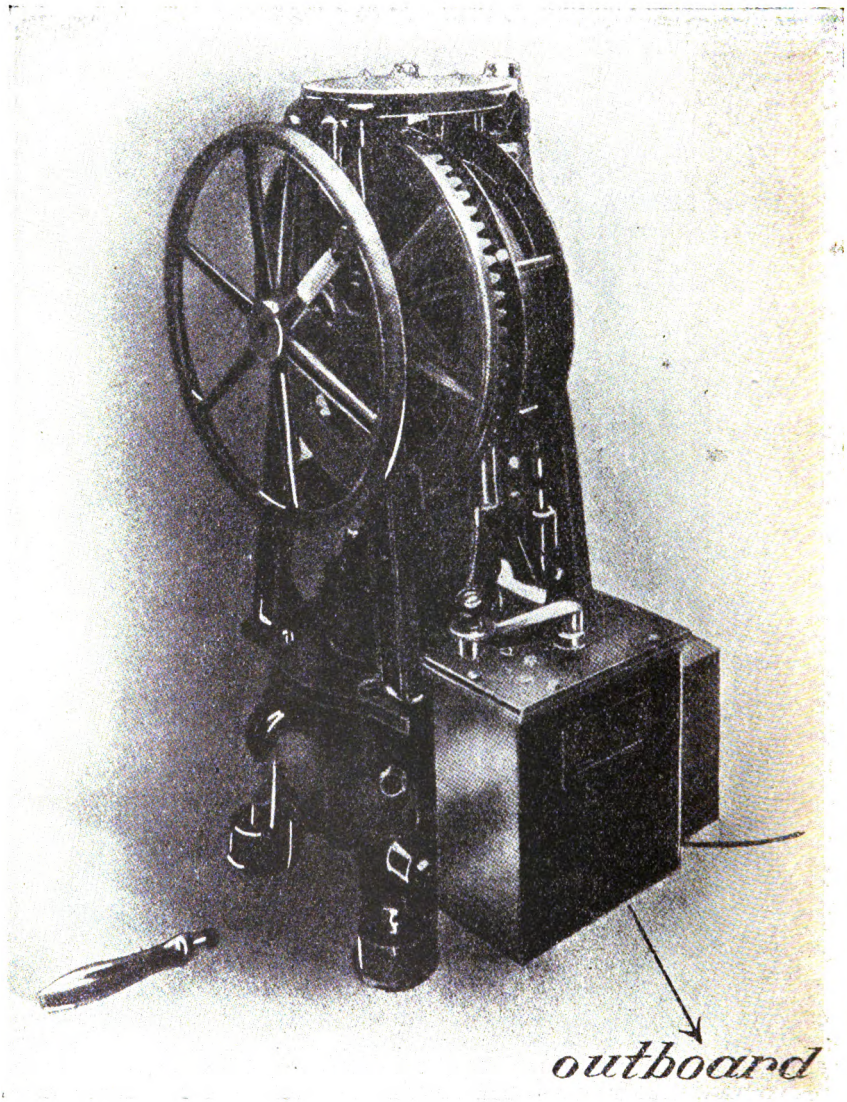

LORD KELVIN'S SOUNDING MACHINE.
Hand and Motor Driven. With all latest improvements.

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motor is switched on for "heaving in," the bevel wheels will be sheared.

If while working the machine the current should give out, or if from any other cause the motor should refuse to haul in, it is not necessary to immediately slacken the screws, but to ship the handle supplied with the machine on to the outer edge of brake wheel. *It can then be used as a hand machine.* But if it is found that it will take some time before the current can be restored, the nuts can be slackened and the machine pulled out of gear.

The machine must always be fixed on board with the motor switch casing *outboard*.

The dial is illuminated for night use by an electric lamp fitted to top of machine on the side opposite from the skeleton hand wheel. It is arranged so that only part of the dial immediately adjacent to a pointer fixed to the lamp case is illuminated. The dial is fixed to the counting gear by a wing nut on the spindle of counting gear. To set the dial to zero, the wing nut is eased, and dial turned by means of two knobs attached, till the zero of dial is underneath pointer, the wing nut is then tightened up.

A switch lever for controlling the lamp will be found on side of junction box attached to motor starter.

LOGS.

The only logs now supplied to ships are the "Trident" electric and non-electric.

The "Cherub" and "Neptune" logs are still in use afloat.

Hand logs and glasses are obsolete.

Neptune Log.—This log has been designed to register accurately at high rates of speed, from 18 knots upwards.

Figs. 1 and 2 represent the registering apparatus which is fixed to the stern of the ship, the rotator being in the water, and connected by means of a long log line with flywheel governor close to the registering apparatus. The case A covers the registering wheelwork, and the intermediate tube E contains the ball bearings, which receive the pull of the rotator and line. When not in use, the register can be withdrawn by raising the small spring button which locks the socket C in the shoe H. Both A and E have large openings formed in them (closed by sliding tubes) to enable the whole of the working parts to be easily accessible for examination and oiling while the log is in use. It is most important that all working parts should be kept well oiled.

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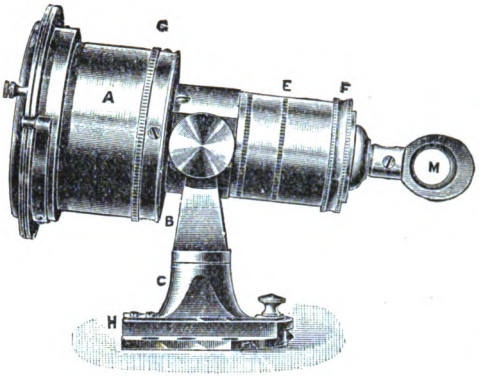

Fig. 1.

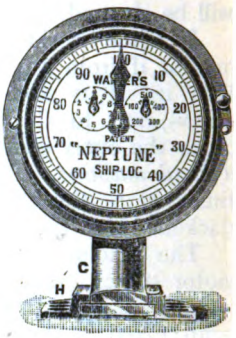

Fig. 2.

The ball bearings, with eye, cap, and spindle, unscrewed from the body of the log, are shown in Fig. 3. The bearings consist of two necklaces of balls rolling in two pairs of V grooves, the outer pair to receive the pull of the Rotator, and the inner for the purpose of adjusting and to prevent side shake. These balls and grooves are enclosed in a skeleton cage which can be unscrewed from the cap F, as shown in Fig. 4, for cleaning or renewal. The adjustment of the bearings is effected by screwing up the cage cap *b*, locked by a specially-formed washer and the two screws, *a*, *a*. Should the outer grooves become worn, the whole cage and bearings can be reversed, and the pull of the line thus transferred to what had previously been the inner, and practically unused, balls and grooves.

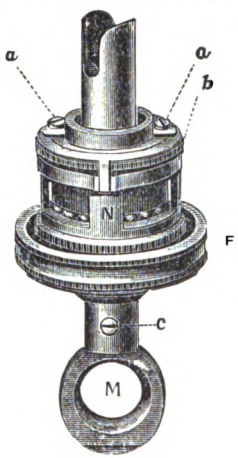

Fig. 3

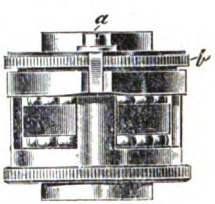

Fig. 4.

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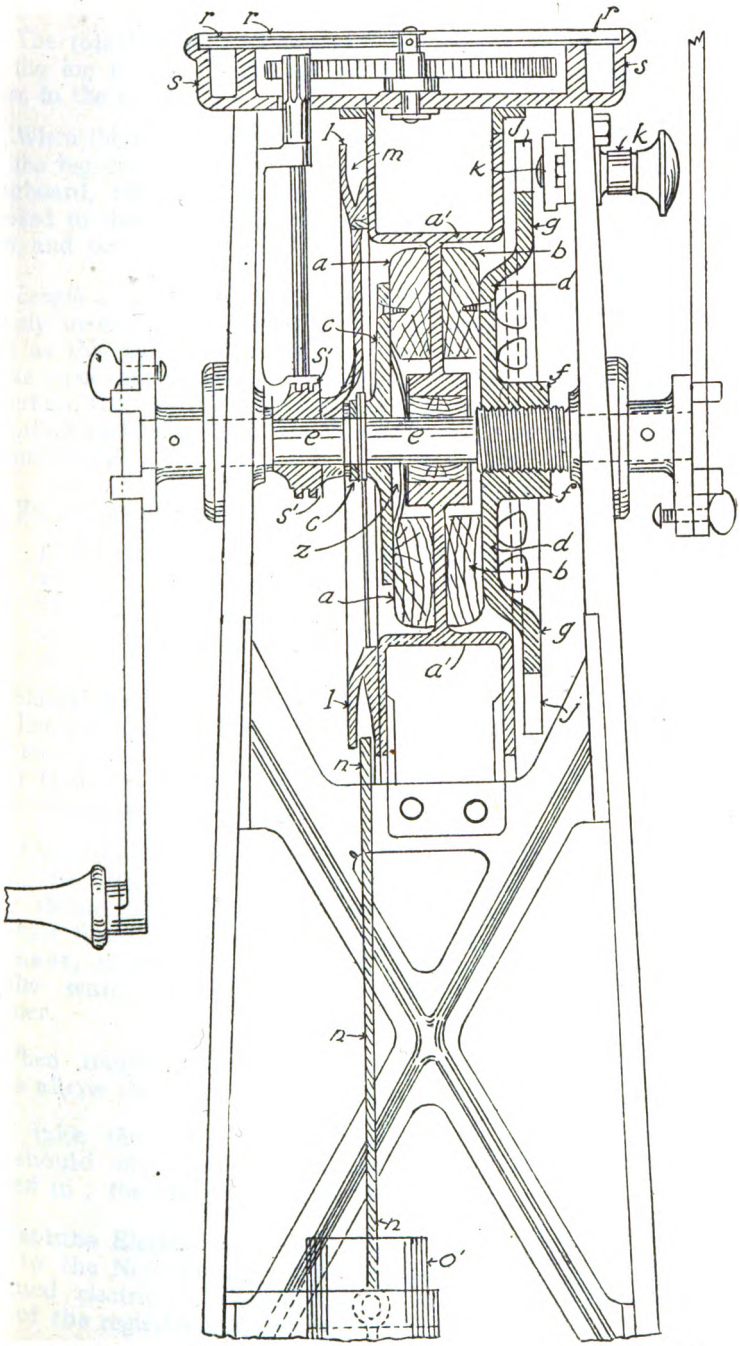
Plate A.



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The rotator and hook are attached to the opposite ends of the log line, and care should be taken that no knot is close to the rotator.

When the log is to be used, the governor wheel is attached to the register by means of the eye M and the rotator put overboard, the hook on the inner end of the line being hooked to the eye of the governor, and the hands set at 0, 100, and 500.

Length of Line.—The accuracy of a patent log depends largely upon its being used with a suitable length of line, and as this will vary in different vessels, it is necessary to make some experiments at sea over a known distance to ascertain the best length for any particular vessel. The following lengths of line have been found to be suitable for normal vessels.

For a maximum speed of—

10 knots	–	40 fathoms of line.
15 ,,	–	50 to 55 ,, ,,
18 ,,	–	60 to 65 ,, ,,
20 ,,	–	70 to 80 ,, ,,
25 ,,	–	100 to 120 ,, ,,

Should the above not give accurate results, lengthening the line will usually be found to increase the Log registration, and *vice versâ*. For small high-speed vessels, such as Torpedo Boat Destroyers and Motor Boats, shorter lines can be used than those given above.

When the correct length of line is found, it should never be altered, and as new lines stretch considerably they should be carefully measured after being in use for the first time. It is better to use too long a line than one too short, as with the longer line, the rotator being deeper in the water, the log will be less affected by rough weather.

When hauling in after use, great care should be taken not to allow the rotator to strike the side of the ship.

To take the turns out of the line, the inner, or hook end should be passed overboard while the rotator is being hauled in; the line can then be hauled in free of turns.

Neptune Electric Log.—This log is similar in construction to the Neptune log, with the addition of a specially-designed electrical make-and-break arrangement inside the case of the registering apparatus on the stern.

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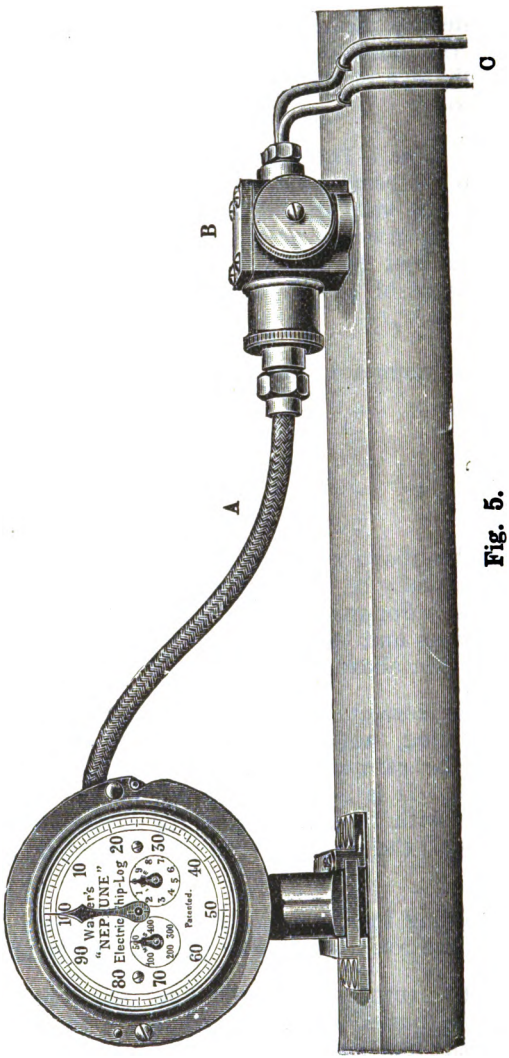

Fig. 5.

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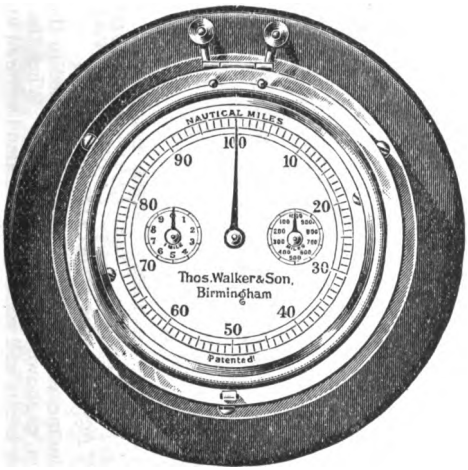
When the log is in use a flexible cable A, Fig. 5 (*see* page 150), is connected to the register, and the outer end connected electrically by a strong brass union in a water-tight connection box B. From this box run two insulated wires to a set of electric batteries and to the forebridge register, Fig. 6. There is, therefore, a complete circuit between the register aft and the register on the forebridge, and at every tenth of a mile an electric impulse is sent through the circuit actuating the electric register, whose dial records the same distance as that registered by the log.

Fig. 6.



Forebridge Register.

Cherub Log.—There are two patterns, the "Cherub" and the "Cherub," Mark II. They are both secured aft in the ship, and fitted with a registering apparatus, a rotator and a wheel-governor K (Fig. 8), which gives steadiness

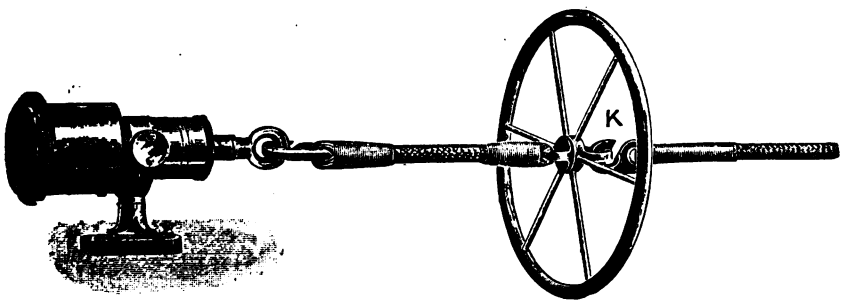


Fig. 8.

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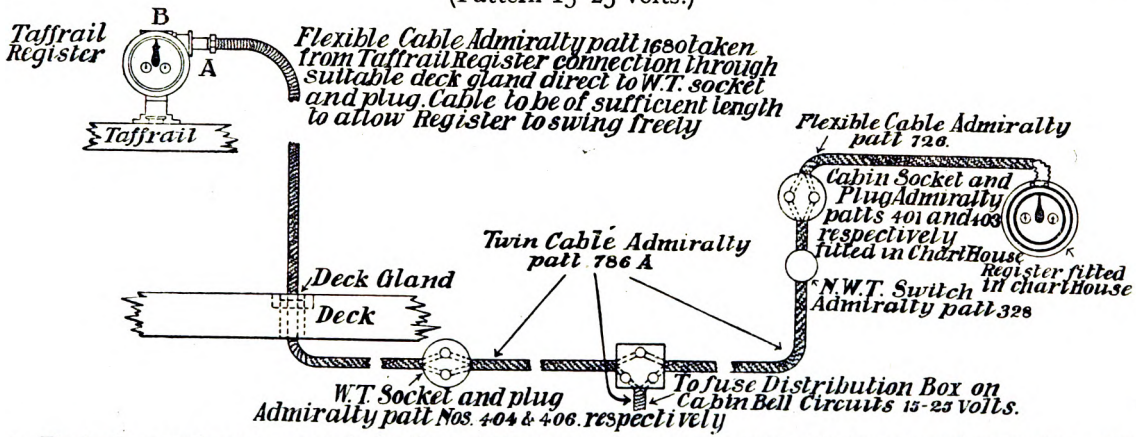
Fig. 7

DIAGRAM OF CIRCUITS FOR WALKER'S PATENT "NEPTUNE" AND "TRIDENT" ELECTRIC LOGS.
(Pattern 15–25 volts.)


B
A
Taffrail Register
Taffrail
Flexible Cable Admiralty patt 1680 taken from Taffrail Register connection through suitable deck gland direct to W.T. socket and plug. Cable to be of sufficient length to allow Register to swing freely
Flexible Cable Admiralty patt 726.
Cabin Socket and Plug Admiralty patts 401 and 403 respectively fitted in Chart House
Register fitted in Chart House
N.W.T. Switch Admiralty patt 328
Twin Cable Admiralty patt 786 A
Deck Gland
Deck
W.T. Socket and plug Admiralty patt Nos. 404 & 406 respectively
To fuse Distribution Box on Cabin Bell Circuits 15-25 volts.

1. The instrument is sent out ready for the metallic flexible cable to be attached to the internal connections of the plug "A" of the Log Taffrail Register, as shown in the above diagram. When the connections have been made it is important to see that the stuffing box is well packed and the gland screwed up tight.
2. If it is desired to use batteries to supply the current instead of taking it off the 15-25 volt bell circuit, it will be necessary to cut out the 100-ohms resistance coil in the box "B" by short-circuiting the connections. For each Chart House Register required, four good firing cells in series giving 6 volts are sufficient.
3. With the exception of the one mile hand of the Chart House Register, which can only be moved backwards, the hands of both taffrail and Chart House Registers can be set in either direction.
4. The resistance of the Chart House Register is 40 ohms.

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to the revolutions of the spindle of the register, and prevents the vibration and jerky action caused by the length of the log line. The case of the Cherub log contains a bell, which rings at every sixth of a mile, thus giving notice of the working of the log.

The Cherub Log, Mark II. (Fig. 9), works with greater accuracy and regularity at varying speeds. The principal changes in the Mark II. are the introduction of ball bearings instead of conical rollers, as in the older pattern, the provision of the sliding case to allow the gear to be oiled while the log is in use, and the strengthening of the eye M (Fig. 9) by the insertion of a hardened steel bush. The register

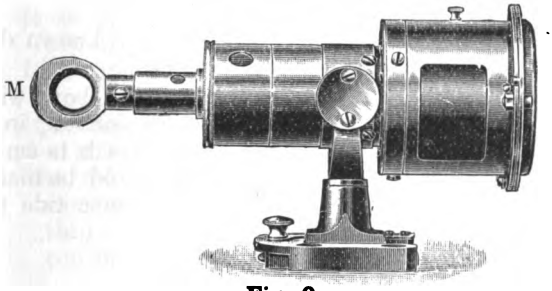
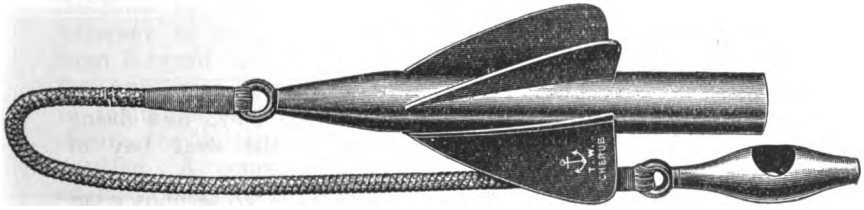


Fig. 9.

has also been balanced, and the internal friction reduced by the absence of the bell-work. It is recommended for speeds up to 18 knots, as being preferable both to the original Cherub and the Neptune patterns.

Some "Cherub" logs are still in use afloat, but when returned to store they are not re-issued.

Fig. 10.



Rotator.

Trident Log.—The "Trident" Log is identical with the "Neptune" High Speed Electric Log as described on page 149, with the following exceptions :—

(*a*) A "Cherub" rotator is used instead of a "Neptune" rotator. (The vanes of the "Cherub" rotator are somewhat larger than those of the "Neptune.")

(*b*) The watertight terminal box is attached to the top of the register itself.

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Note.—It must be borne in mind that the revolutions of the engines give at least as reliable an indication of the speed in a large ship as any patent log, provided weather conditions are moderate and the ship's bottom is not foul. (Revolution tables are always made out for a ship with a clean bottom.)

All patent logs have their errors, which should be found and recorded as a percentage of the distance the log actually shows, and not as a percentage of the distance actually run. These errors may be found in two ways, the second of which is to be preferred, as being the more accurate :—

(1) From a run between two points at a known distance apart, due allowance being made for tides.

(2) From runs over a measured distance, both with and against the tide; an example of which follows, in which it should be noted that the mean of the speeds is employed, and not the mean of the times, which would be manifestly incorrect, as the ship is longer in the adverse tide than in the one in her favour.

Example :—

Times by Watch.				Patent Log shows	Revolutions.
				Knots.	
1st run.	4	28	18	9 5	44
	4	40	47	11 2 (against tide).	
2nd run.	4	53	27	12 8	
	5	03	04	14 2 (with tide).	

The measured distance run over being 8,678 feet (being the distance between the beacons in the west bay of Portland).

The first run of 8,678 feet in 12 minutes 29 seconds gives speed of 6·85 knots.

The second run of 8,678 feet in 9 minutes 37 seconds gives speed of 8·91 knots.

Mean speed is therefore 7·88 knots.

But patent log shows 3.1 knots in the total running time of 22 minutes 6 seconds, which, by simple proportion, gives 8·39 knots. But the actual speed is 7·88 knots.

Therefore, the error of the log is ·51 miles overlogged in 8·39, or 6·1 in a hundred.

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Forbes' Ship's Log and Speed Indicators.

The Forbes' Ship's Log and Speed Indicator is an apparatus for correctly registering the distance travelled by a ship through the water, and for indicating the actual speed in knots at which the ship is moving through the water at any moment.

The chief advantages of this instrument are—

(1) Its accuracy over a wide range of speeds (speeds as low as four knots can be indicated).
(2) It is ready for use at any moment.
(3) It is not damaged by the ship going astern.
(4) It is accurate in any weather however rough the sea may be.
(5) It is not liable to become choked with floating weed.
(6) It cannot be damaged by other ships as in the case of a log towed astern.
(7) The records of distance and indications of speed can be carried to any desired position in the ship—as many as six sets of the instruments can be operated in six different positions.
(8) Any variation of speed due to increased slip of the ship's propellers can be immediately observed and allowed for or corrected. (This is of great importance in turbine-driven vessels.)

Description of the Apparatus.—The apparatus consists of a sea cock or valve fitted in the bottom of the ship, preferably about one-third of the length of the ship from the bows, or as near as possible to the point about which the ship turns. In selecting the position for the log it is desirable to minimise the effect of the "frictional wake" adjacent to the hull, which rapidly increases in thickness from forward to aft. A position well forward would therefore appear to be best, but at the same time it is desirable to minimise the effect of pitching motions, and for this reason the instrument should be as nearly amidships as possible. A compromise between these two is therefore effected, and the "pivoting point" of the ship as nearly as possible meets this compromise.

Through the sea cock protrudes a manganese bronze tube having one opening facing forward for the admission of water as the tube is carried forward by the ship, and another opening facing aft to allow the water to escape. Between these two openings is a propeller operating the transmitting mechanism, and so designed as to make a certain number of definite revolutions while the ship travels one sea mile.

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The whole of the tube which protrudes through the ship's bottom can, at any time, be drawn up into the interior of the ship, and then, after the sea cock is closed, the apparatus can be removed for examination, cleaning, &c. Guide rods are provided attached to the casting of the body of the sea cock to keep the tube in position when drawn into the ship, and also to keep the openings in the tube facing correctly fore and aft when the tube is pushed down.

Fig. 1 illustrates the valve, with the tube pushed down so as to protrude 15 inches through the bottom of the ship.

Fig. 2 shows the same mechanism with the tube drawn up and the valve closed.

At the top of the tube is fixed a casing, in which is fitted :—

(*a*) A *Commutator* for transmitting electric signals to the Distance Recorder, which is arranged so that 100 electric signals are made while the ship travels 2,027 yards—or one sea mile.

(*b*) A *Magneto Generator*—which generates current at a pressure proportional to the speed at which it revolves, this current being led to one or more voltmeters, having the scale marked in knots, and which accordingly serves to indicate the speed of the transmitting apparatus, and therefore of the ship through the water.

This apparatus is driven by means of gearing from a shaft rotated by the propeller in the tube, and an arrangement of change wheels is provided so that corrections or adjustments can readily be made.

Any alteration of the change of wheels affects *both the Distance Recorder and the Speed Indicator*, so that the indication of these two instruments maintains a consistent relation one to the other.

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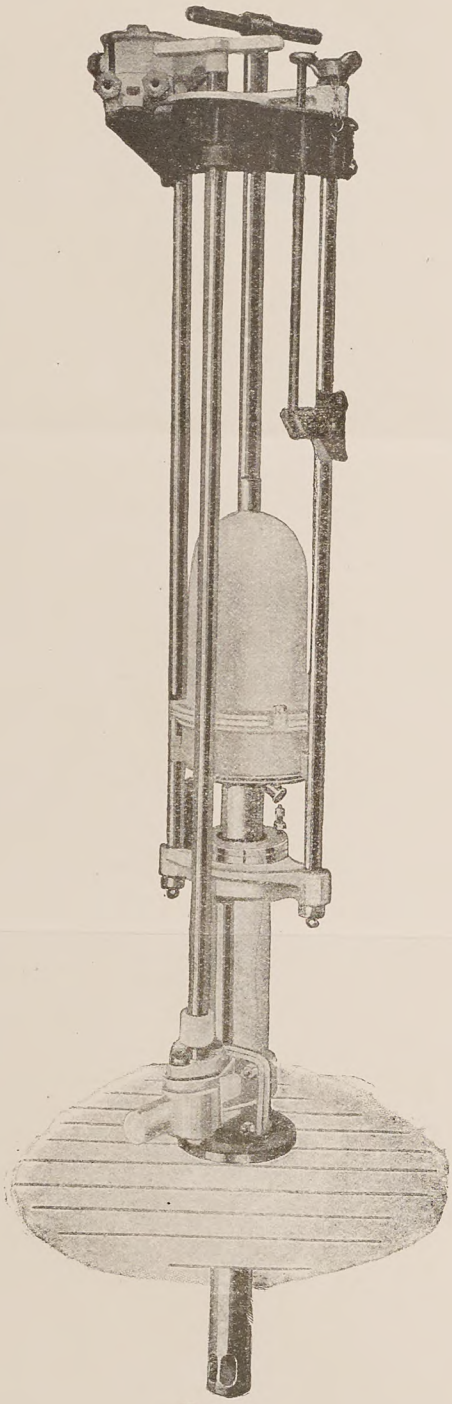

Fig. 1.

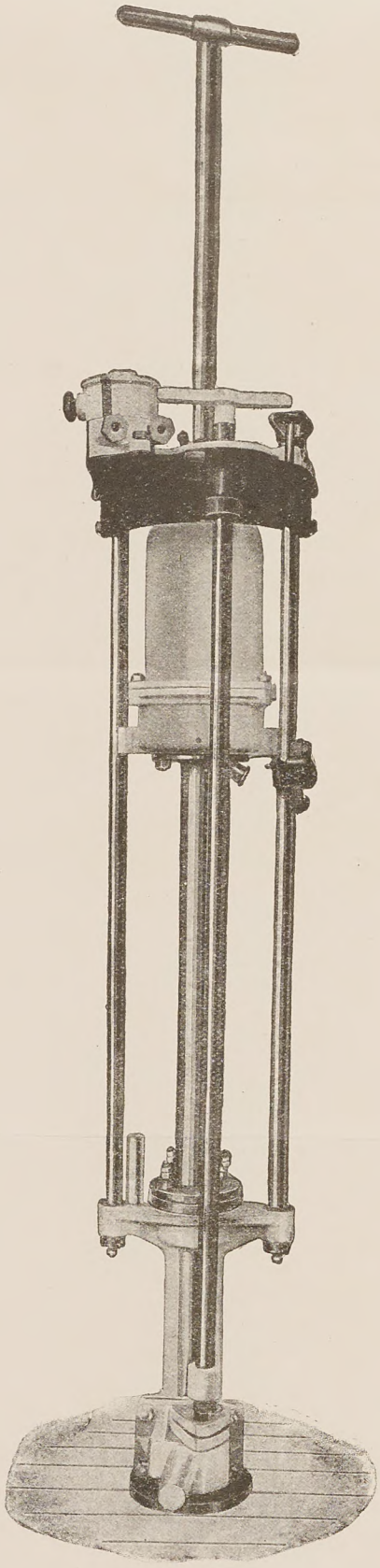

Fig. 2.

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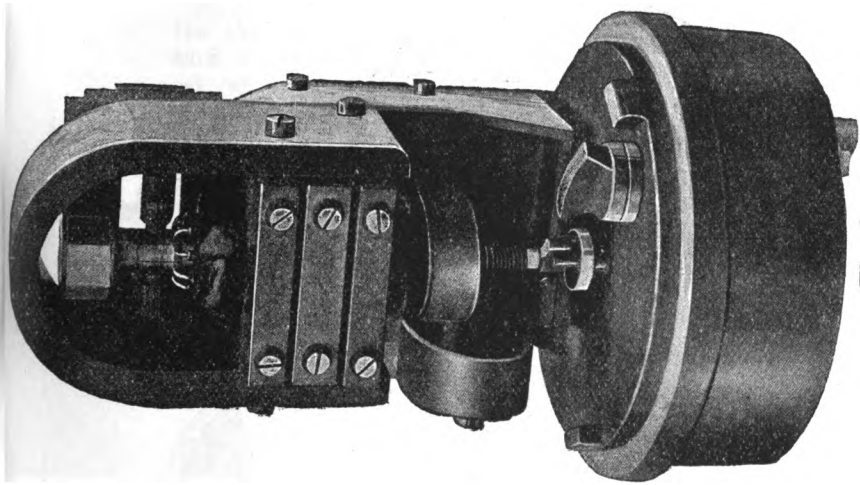

Fig. 4.

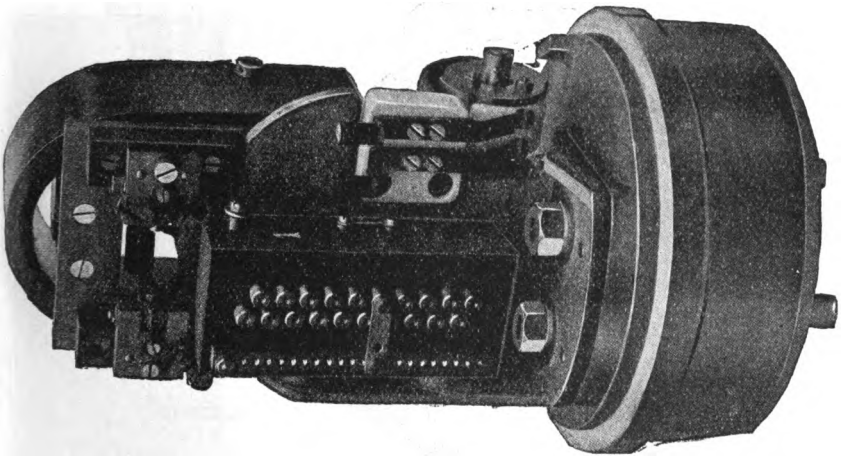

Fig. 3. Transmitter and Magneto.

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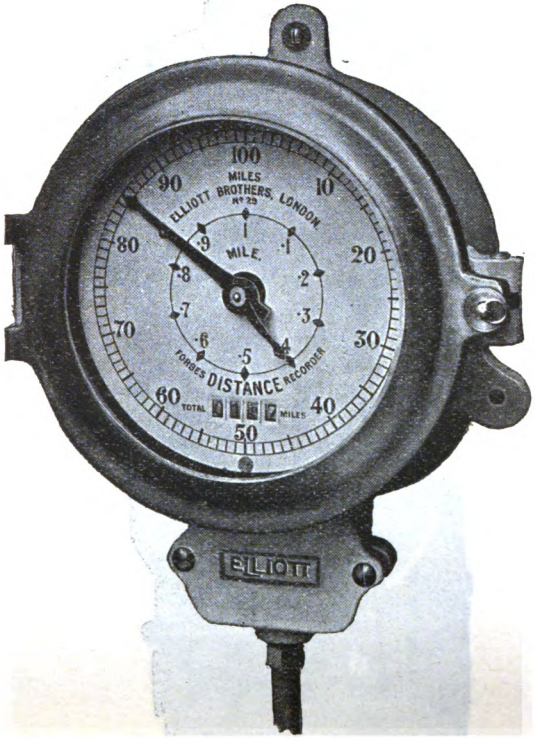

Fig. 5.
Distance Recorder.

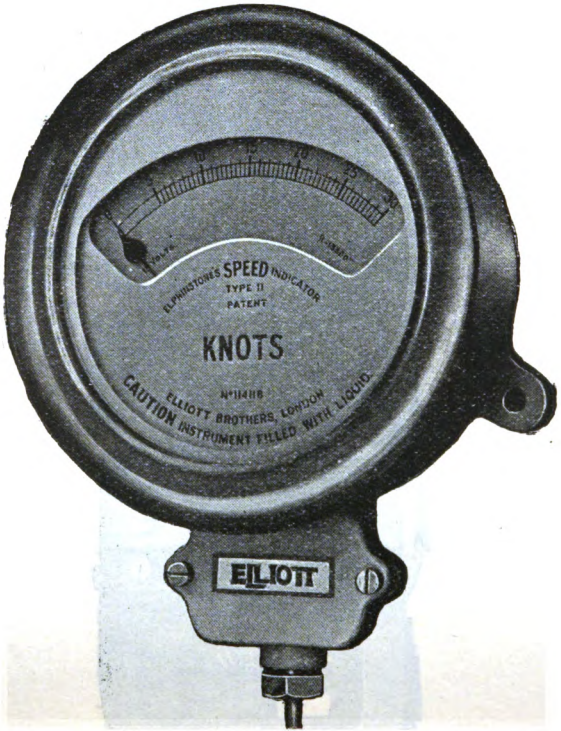

Fig. 6.
Speed Indicator.

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The indications on the two instruments are arranged in the following manner :—

The Distance Recorder (Figs. 5 and 7).—A red pointer makes one revolution for each sea mile travelled by the ship. A black pointer makes one revolution for each 100 miles. Each of these two pointers can be set at zero at any moment. The total distance travelled by the ship when the log is in use is registered on figures at a small window in the dial.

The Speed Indicator (Fig. 6).—The pointer indicates the exact speed of the ship through the water at any moment ; various ranges of speed can be dealt with—that is to say, a dial can be provided so that speeds from 0 to 20 knots are shown, or speeds from 0 to 30 as necessary. The indicators can be fitted up in any position in the ship required.

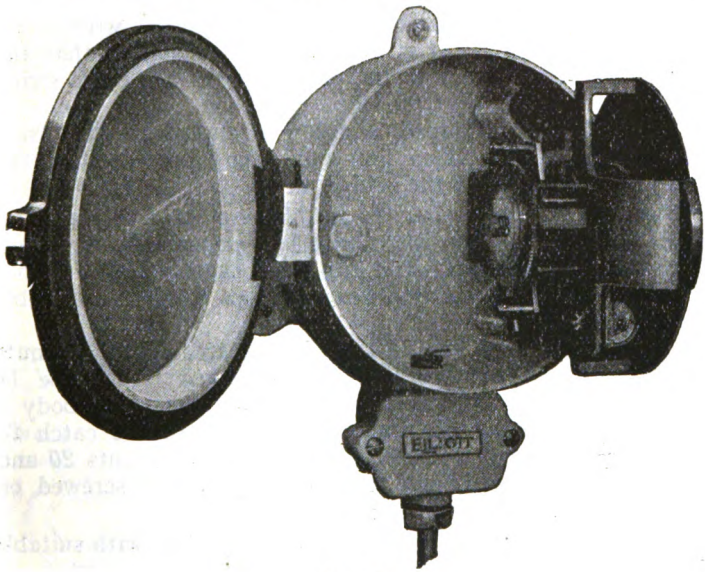

Fig. 7.

Distance Recorder.

Showing case open and accessibility of mechanism.

Fitting and Using Forbes' Distance Recorder and Elphinstone's Speed Indicator.

A position in the bottom of the ship is decided upon so that the log may be in a vertical position with sufficient space round it to allow the mechanism to be got at.

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Figure 8 shows the transmitting apparatus as fitted to double-bottomed ships.

Transmitting apparatus. A hole 2½ ins. in diameter is cut in the outer skin *1* of the ship, and a zinc ring *2* is fixed to the outside of the skin. A steel levelling ring *3*, having studs to suit the holes in the sea valve *4*, is riveted to the bottom. Great care is taken to get the holes in *1*, *2* and *3* perfectly concentric.

Vertically over the hole in the outer skin an oval hole is cut in the inner skin *5*, and a hinged man-hole 6 having an opening not less than 17 ins. by 23 ins. is riveted to it.

The coaming of the man-hole *6* is made so that the total height of the log may be accommodated; *i.e.*, 5 ft. 3 ins. from the top of the steel levelling ring *3*.

The sea valve *4* (which has fixed to it two steel guide roads *7* and *8*, a half-moon shaped bridge *9*, a straight bridge *10*, and the valve operating handle *11*) is bolted into position as shown. The valve body is painted with a red and a green stripe. It is important to remember that the red stripe should point to the port side and the green stripe to the starboard side of the ship.

The half-moon shaped bridge *9* is stayed to the inside of the coaming at *12*, a bolt hole being provided for the purpose in the side of the bridge at *13*.

Watertight deck tubes, *14* and *15*, are fitted to the inner skin *5* of the ship, and wired with two armoured core cables. Two ends of these cables run into the socket *16* and the other two ends run to a junction box, which is fixed to a suitable bulkhead.

To fit the Log Tube *18* and Transmitter *19* the fly nuts *20* and *21* and the bridge *10* are removed; the tube *18* with transmitter *19* is then lowered into the valve body *4* and held in dotted position *22* by means of the catch *23* on the guide rod *7*. The bridge *10* and the fly-nuts *20* and *21* are now replaced, and the operating rod *24* screwed on to the top of the Transmitter *19*.

The gland *25* of the valve sleeve *4* is packed with suitable hydraulic packing and the gland *25* screwed down.

The handle for operating the valve is shown at *11*.

To put the Log into action the valve operating handle *11* is turned to position *0* (open) indicated on a segment on the half-moon shaped bridge *9*, and the handle *24* up about ½ in., the knob *26* is kept pressed downwards and the Transmitter *19* and Tube *18* pushed slowly downwards by pressing down the operating handle *24* until *19* comes to rest on the stop *27*.

As an extra safeguard the valve is shut when the Transmitter and Tube are pulled up as shown dotted at *22*.

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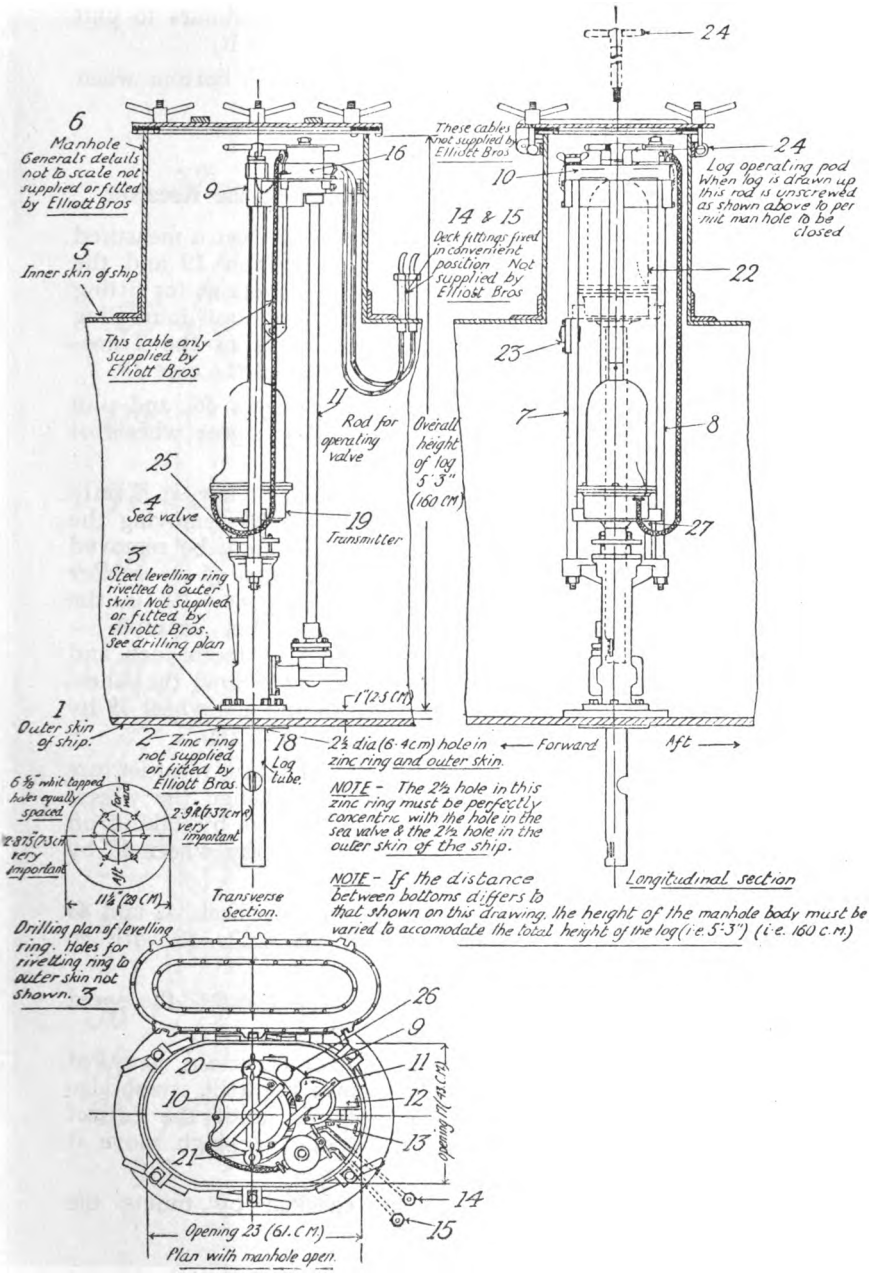
24
6
Manhole
Generals details not to scale not supplied or fitted by Elliott Bros
These cables not supplied by Elliott Bros
16
9
10
24
Log operating pod
When log is drawn up this rod is unscrewed as shown above to permit man hole to be closed
14 & 15
Deck fittings fixed in convenient position Not supplied by Elliott Bros
5
Inner skin of ship
22
This cable only supplied by Elliott Bros
23
11
Rod for operating valve
Overall height of log 5'3" (160 cm)
7
8
25
4
Sea valve
19
Transmitter
27
3
Steel levelling ring rivetted to outer skin Not supplied or fitted by Elliott Bros. See drilling plan
1'(23 cm)
1
Outer skin of ship.
2
Zinc ring not supplied or fitted by Elliott Bros
18
Log tube.
2½ dia (6·4 cm) hole in zinc ring and outer skin.
← Forward
Aft →
6 5/16" whit tapped holes equally spaced
2·9375(7·3 cm) very important
2·375(7·3 cm) very important
11½" (29 cm)
Transverse Section.
NOTE - The 2½ hole in this zinc ring must be perfectly concentric with the hole in the sea valve & the 2½ hole in the outer skin of the ship.
NOTE - If the distance between bottoms differs to that shown on this drawing, the height of the manhole body must be varied to accomodate the total height of the log (i.e. 5'3") (i.e. 160 c.m)
Longitudinal section
Drilling plan of levelling ring. Holes for rivetting ring to outer skin not shown. 3
26
9
20
11
10
12
13
21
14
15
Opening 23 (61. c.m)
Plan with manhole open.

Fig. 8.

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It is desirable when in or approaching harbours to pull up the tube so that hawsers, &c., may not foul it.

The tube projects 15 ins. below the ship's bottom when pushed down.

Instructions for Adjusting the Readings of the Receiver.

If the readings of the Distance Recorder over a measured distance are not correct, take the Transmitter *19* and the Log Tube *18* (*see* Fig. 8) in board (*see* instructions for fitting the Log) and remove the Dome *31*. Pull out four Plug connections *32*, *33*, *34* and *35*. The whole of the Transmitting mechanism may now be lifted clear of the case *19*.

Lay it on its side and unscrew the screws *36*, and pull the cover *37* off. This plate carries all the gear wheels of the transmitter.

If the Log is not more than 7½% high or low, it is only necessary to change the wheels *38* and *39* by removing the three screws *40*, after which the plate *41* may be removed and the wheels *38* and *39* changed. The *sum of the number of teeth on these wheels must always be* 180. *38* is the driving wheel and *39* the driven wheel. For example :— Assuming the wheels *38* and *39* contain 90 teeth each and the distance recorder is found to read 2½% low, the wheel *38* must be replaced by one of 91 teeth and the wheel *39* by one of 89 teeth. (Sum of teeth = 91 + 89 = 180.)

If, however, the readings of the distance recorder are more than 7½% out, it is necessary to change the wheels *42* and *43*. The wheel *42* may be removed by taking off the bracket *44* and the split pin *45*, and the wheel *43* by removing the split pin *46*.

The sum of the number of teeth on the wheels *42* and *43* must be 128. At present these wheels are :—*42* with 70 teeth, *43* with 58 teeth.

The distance recorder having been put right, the speed indicator now receives attention.

If the speed indicator readings over a certain measured distance in a certain time are low move the little crossbridge *47* on the resistance box *48* upwards until the correct reading is attained. If the indications are high move it downwards.

The speed indicator can be checked by timing the movement of the distance recorder.

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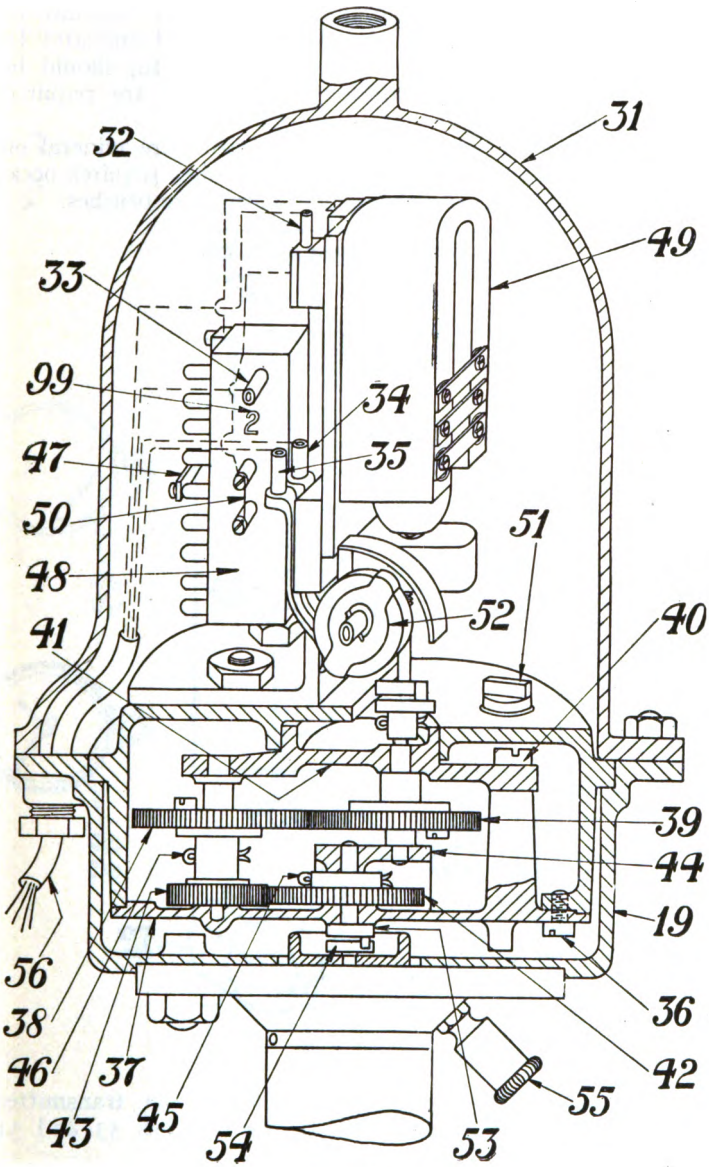

Fig. 9.

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General Instructions.

The magnet 49 (*see* Fig. 9) should on no account be removed at any time. If an additional speed indicator be fitted in the ship one of the wires 50 (Fig. 10) should be cut through, or if two additional indicators are required both the wires 50.

The transmitter gear box is filled with pure mineral oil at 51. The commutator 52 with its brushes requires occasional cleaning, and also the magneto armature brushes.

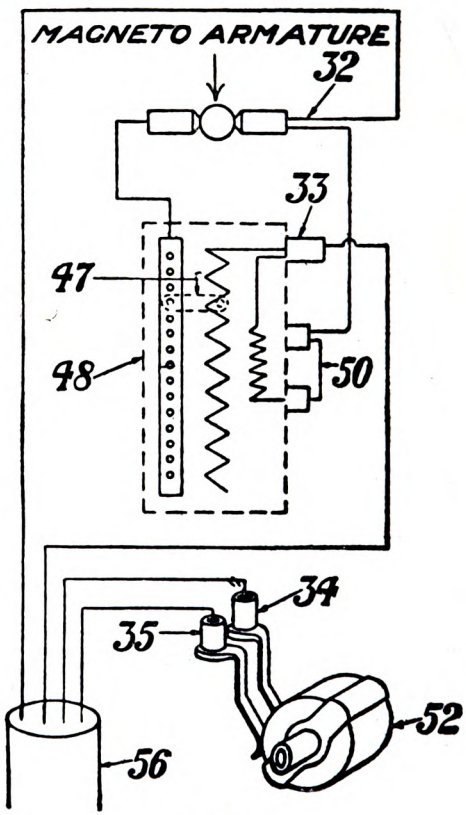

Fig. 10.

Care must be taken when replacing the transmitter mechanism into the case 19 that the clutches 53 and 54 engage properly.

An occasional half-turn should be given to the lubricator 55 which lubricates the water-tight spindle of the clutch 54.

Fig. 10 shows the electrical connections of the transmitter.

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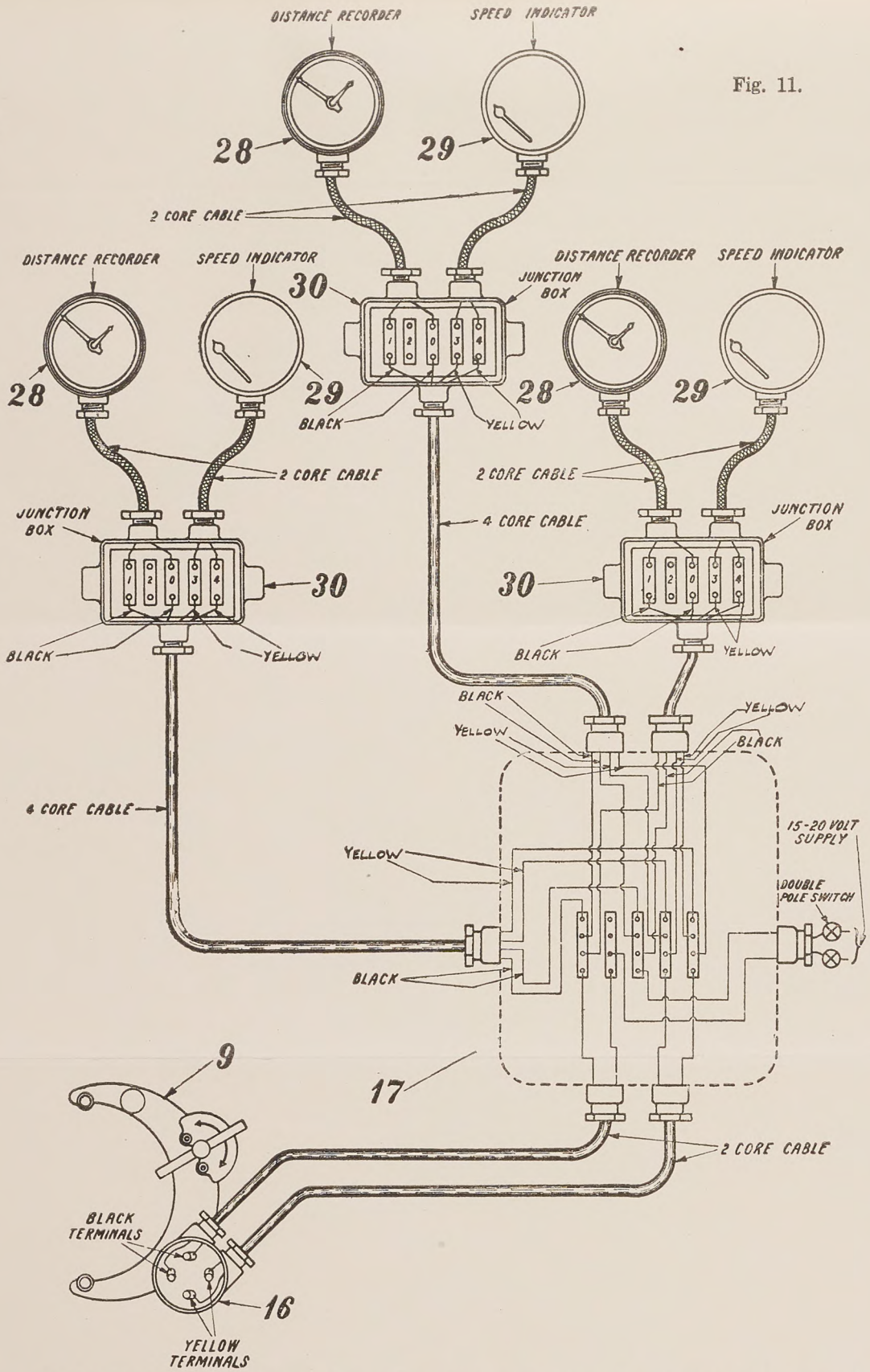
Fig. 11.



RECEIVING APPARATUS.—Fig. 11 shows the arrangement of three sets of receiving apparatus and the way in which the leads are connected.

Each set consisting of one Distance Recorder *28*, one Speed Indicator *29*, and one Junction Box *30*.

The Distance Recorder registers 1/100 of a knot every electrical contact, the red hand making one revolution per knot, and the black hand one revolution per 100 knots; and the total miles run since Log was fitted is shown by the figures in the window.

The Speed Indicator shows the speed in knots. The Distance Recorder is wound for a 15 volt. circuit. The cables are only required to carry $\frac{1}{4}$ ampere.

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Forbes' Log.—Step by step movement. The following table gives the interval of time between contacts, at the rate of 100 per knot at various speeds :—

Speed.	Time.	Speed.	Time.
5 Knots	7·2 Seconds.	18 Knots	2 Seconds.
6 ,,	6 ,,	19 ,,	1·9 ,,
7 ,,	5·14 ,,	20 ,,	1·8 ,,
8 ,,	4·5 ,,	21 ,,	1·72 ,,
9 ,,	4 ,,	22 ,,	1·64 ,,
10 ,,	3·6 ,,	23 ,,	1·56 ,,
11 ,,	3·28 ,,	24 ,,	1·5 ,,
12 ,,	3 ,,	25 ,,	1·44 ,,
13 ,,	2·8 ,,	26 ,,	1·38 ,,
14 ,,	2·6 ,,	27 ,,	1·33 ,,
15 ,,	2·4 ,,	28 ,,	1·28 ,,
16 ,,	2·25 ,,	29 ,,	1·24 ,,
17 ,,	2·1 ,,	30 ,,	1·2 ,,

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CHAPTER V.

THE MARINER'S COMPASS.

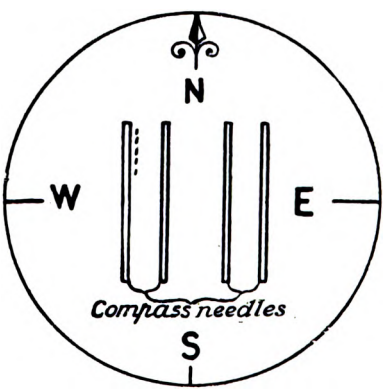
The mariner's compass is an instrument which indicates direction, and by its use the mariner is enabled to guide a ship in any required direction and to ascertain the direction of any visible object such as another ship or point of land.

The compass is constructed on the principle of suspending a magnet (or system of magnets fixed parallel to each other, and referred to as "the compass needles"), in such a manner that, remaining horizontal, they are free to take up the direction in which the magnetism of the earth directs them; this direction is called the "magnetic meridian."

A circular, graduated card, called the "compass card," is fixed to the compass needles so that one diameter, the opposite extremities of which are marked North and South respectively, is in the same line as the direction of the needles, the point marked North, distinguished by a fleur-de-lis, or other special mark, being over that end of the needles which always point to the Northward.

The extremities of that diameter which is at right angles to the North and South line, are marked East and West, East being to the right hand when the helmsman is facing to the northward.

The compass card is thus divided into four quarters of a circle or quadrant.



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Each quadrant is further divided into eight equal parts, the division marks being called "points," each having distinctive names given to it.

There are thus 32 points in the whole card.

Each point is further sub-divided into "half" and "quarter" points, also distinguished by separate names.

The outer edge of the card is divided into 360 degrees (90° in each quadrant), marked from the North and South points 0° to East and West 90°.

In the centre of the card is fitted a small sapphire cap, slightly hollowed on its underneath side, which supports the card by resting on a sharp-pointed pivot, the point of which is made of iridium, a very hard metal; thus the card is supported on an almost frictionless point and is free to maintain its direction when the ship is turned.

The pivot is fixed to the centre of a hemispherical copper or brass bowl, called the "compass bowl," weighted at its lower part by means of a lead weight (or fitted with an oil chamber), the object of which is to prevent the bowl swinging about.

The bowl is covered by a glass plate to protect the card from the effects of damp and also from being blown about by the wind. In the centre of the glass top there is a small fitting in which an upright wire or pin, called the "shadow pin," can be shipped.

On the inside surface of the bowl is painted a thin vertical black line, called the lubber's line or lubber's point, in such a position as indicates the ship's head.

The lubber's point, when the compass is in place, should be in such a position that the line joining it to the pivot of the compass is in line with the ship's keel.

The stand or binnacle in which the compass bowl is shipped, being secured to, and part of, the ship, it follows that the lubber's point moves with every movement of the ship's head, and to ascertain the direction of the ship's head, a helmsman has only to notice the point of the compass card which is in line with the lubber's point, and this is the "compass course," or direction of the ship's head.

Binnacle.—The stand in which the compass bowl is fixed is called a "binnacle," and is generally made of wood with brass fittings.

Inside the binnacle arrangements are made for placing horizontal and vertical magnets, and outside the binnacle are two brackets, one on each side, to which are secured hollow soft iron spheres; there is also a vertical brass cylindrical case in which a bar of soft iron, called the "Flinder's bar," can be placed.

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These magnets and soft iron fittings are the correctors used in adjusting the compass, and they should on no account be moved except when adjusting the compass.

The hood or top of the binnacle is made of brass and so fitted that it can be turned round in any direction, and by means of doors or windows the compass card can be read without removing the hood.

The compass bowl is secured to the binnacle by a gimbal ring, so that when the ship rolls or pitches the compass bowl retains a position with its top horizontal and pivot vertical.

A suspended magnet or compass needle does not point to the True or Geographical North, but to a point known as the Magnetic North Pole, and the difference between this direction and the direction of the True North is called the "variation of the compass," or, shortly, the "variation"; the amount of it at different places is known.

On board steel or iron vessels the compass (unless perfectly adjusted) does not even point to the Magnetic North, as it is influenced by the magnetism of the iron in the ship; the difference between the direction of the Magnetic North and the direction of North as shown by the compass on board is called the "deviation of the compass," and has to be ascertained by the process of swinging ship or by some other means, and has to be constantly checked, as it frequently changes.

For some years previous to 1906 the approved patterns of compasses in use in H.M. Navy were Lord Kelvin's (Sir William Thomson's) Compass and the Liquid Compass, known as Pattern 24.

In **Kelvin's Compasses,** of which there are still a large number in use, the cards are made as light as possible and consist of a ring of aluminium at the outer edge, connected by silk threads to a central aluminium boss in which a small inverted cup, containing the sapphire cap, fits. The graduations of the card are printed on paper, gummed to the outer ring, and the paper cut at intervals to prevent the effects of damp, &c., distorting the graduations.

The needles, six or eight in number, consist of short fine wires and are attached to the card by silk threads.

These compasses are particularly sensitive to shock, such as is experienced on firing guns or to vibration set up when the ship is steaming at high speeds, the effects of which are to disturb the card from its proper direction and render it difficult to steer by, and it was in 1906 superseded by an improved liquid compass.

Liquid Compasses, so called because the bowl is filled with liquid, which prevents the card from being disturbed

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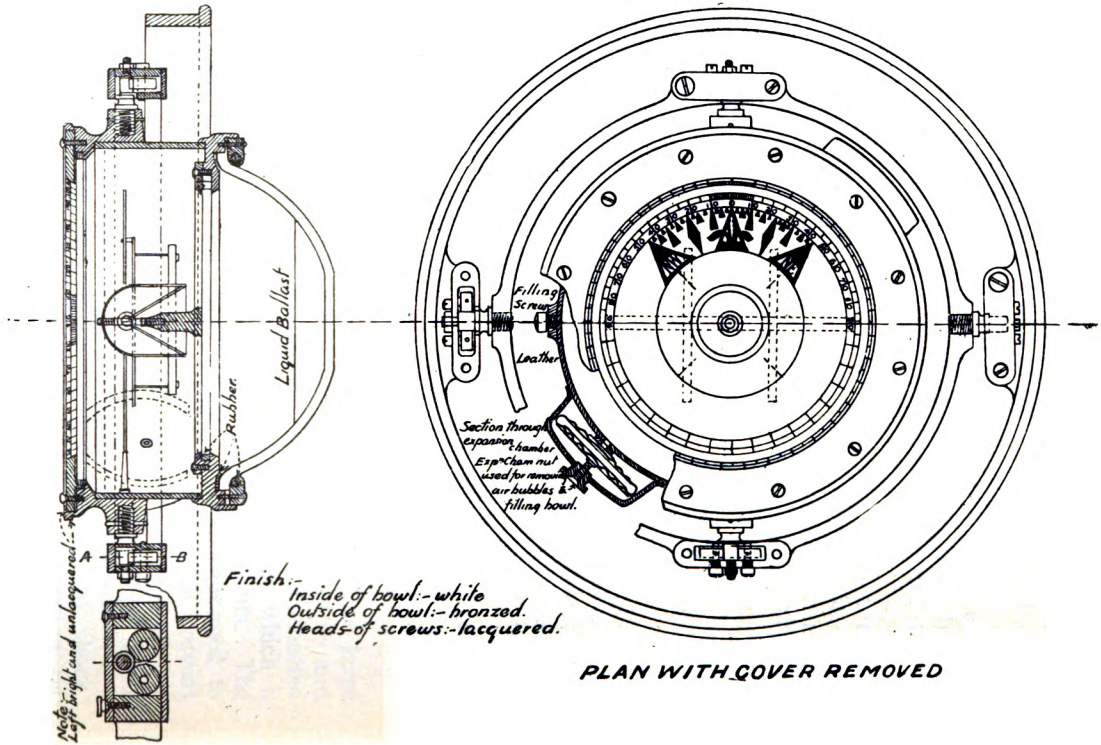
ASSEMBLY OF CHETWYND'S IMPROVED COMPASS BOWL.

Patt. 22a. Built up Type.



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by shocks from gun-fire or vibration, are made as follows :—

The bowl is made of brass, and has attached to it one (or two) corrugated expansion chambers, which maintain an equal pressure on the liquid in the bowl when it expands or contracts on account of changes in temperature. The top (or verge) of the bowl is made watertight by indiarubber packing. In some compasses the lower part of the bowl is made of toughened glass, and consists of two parts, the upper a flat glass and the lower hemispherical, the chamber between the two being partly filled with oil.

The object of this glass bottom is to enable the compass to be illuminated at night by means of a lamp placed underneath the bowl.

In these compasses there are two expansion chambers attached on opposite sides of the upper or brass part of the bowl.

In other compasses the bowl is made entirely of brass, and instead of an oil chamber has a lead weight at the bottom, and a single expansion chamber also in the bottom.

In the latest compasses (Chetwynd's improved) the lubber's point consists of a fine pointed wire, projecting inwardly from the bowl, level with the card, and its point close to the edge of the card.

The compass card is made of mica on which the graduations are painted, and the diameter of the card is about three-quarters of the diameter of the bowl, by which means any disturbance of the card when altering the direction of the ship's head, or on gun-fire, &c., is obviated.

The needles, two or four in number, are round bar magnets.

To reduce the weight of the card by giving it a certain amount of flotation, and thus reduce the friction between the cap and pivot, a hollow copper float is attached to the centre of the card, and the sapphire cap is fixed to the centre of this float.

The liquid with which the bowl is filled consists of a mixture of alcohol and water (one part alcohol to two parts water).

In steering compasses, on the upper edge or verge of the compass and over the lubber's point, is attached a glass magnifying prism, in which the lubber's point and the graduations of the card are magnified and reflected to the helmsman's eye, thus enabling him to detect any movement of the ship's head more readily than is possible by reading the card direct.

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Binnacles.—In the latest binnacles (Chetwynd and Kelvin's patent) a system of mechanism is fitted, by means of which the correcting magnets are moved up or down as may be required for adjusting the compass; in those binnacles for use with the glass-bottomed compass bowl there is a fitting for an electric lamp inside the binnacle, and above this lamp and between it and the compass bowl is a brass screen with a movable shutter in the centre of it, by means of which the amount of light admitted to the compass is regulated as desired.

As an alternative to the electric light, an oil lamp is supplied to fit into the side of the binnacle.

The Gyro Compass.

The Gyro Compass is an instrument the construction of which is based on the mechanical laws governing rotating bodies.

Briefly stated these are as follows :—

"Any rotating mass, such as a spinning wheel, tends to swing round so as to bring its axis of rotation parallel to that of any externally applied force and in such a relation that its direction of rotation is the same as that of the applied force."

In the case of the Gyro Compass, the applied force is that of the Earth revolving about its axis. We, therefore, have a natural Gyro in the Earth and an artificial one in the Gyro Compass as analogous to the Earth as a natural magnet and the magnetic compass as an artificial one; direction can, therefore, be found by one means as with the other. A freely suspended Gyro, *i.e.*, one capable of spinning on its own axis, also moving about a vertical and horizontal axis and unaffected by gravity, when set spinning tends to keep its axis pointing in the same direction in space, but if forcibly deflected, the axis will move in a direction determined by that of the disturbing force.

In the case of the Gyro Compass, this disturbing force is gravity.

To show how this disturbing force acts, no better example can be taken than that of a wheel or hoop being bowled along the ground.

As long as the hoop remains upright and speed is maintained, the centre travels in a straight line; but if a force is impressed at the top on the right-hand side viewed from behind, the hoop gradually travels to the left and falls over to the left; to right it again, a force must be impressed at the top on the left-hand side.

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This movement in the hoop is more or less exactly reproduced in the Gyro Compass as follows and is known as precession :—

The Compass when steady points approximately to True North, *i.e.*, its axis parallel to that of the Earth and horizontal ; if you wish to deflect the compass, a force must be impressed at the top as in the case of the hoop, in other words a tilting movement is given to the axis of the Gyro ; when the compass is deflected the axis is no longer horizontal, the amount of the tilt depending on the amount of deflection ; if the compass is now left alone, the force of gravity acting on the tilted axis provides a couple precessing it back to the meridian again. This precessional movement would go on indefinitely, if some means were not taken of damping it and finally stopping it ; this is accomplished in different ways, according to the type of instrument and is described later.

It has already been stated that the compass points approximately to the True North ; this statement requires amplification.

A Gyro Compass at the Equator, where the directive force is at a maximum, points True North, but as the compass is moved towards the poles, where the directive force is nil, the gradual diminution of this force causes slight changes in the settling point, depending on the latitude and the construction of the instrument.

Furthermore, when a Gyro Compass is placed on board ship, deflection is caused by the forward movement when steaming other than on an E. and W. course, the amount being dependent on the latitude, course, and speed ; the resulting effects can be either tabulated and applied as deviation in the same manner as in the Magnetic Compass ; this is done in the Anschutz Compass, or compensated for as in the Sperry.

Having briefly discussed the principle of the Gyro Compass, the two types in use will be described :—

Anschutz Compass.—Three small gyros are used in this instrument and are attached to the card as shown at A, B, and C, Fig. 1, the pecked lines representing the casings surrounding the gyro wheels.

The gyro on the South side of the card A in Fig. 1 might be described as the " directive gyro " and the other two the " compensating gyros," though they also supply a measure of directive force.

The necessity for compensating gyros is due to the fact that when rolling and pitching on inter-cardinal points a compass with only a single gyro is more or less seriously affected, the amount of the disturbance depending on the

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Fig. 1.

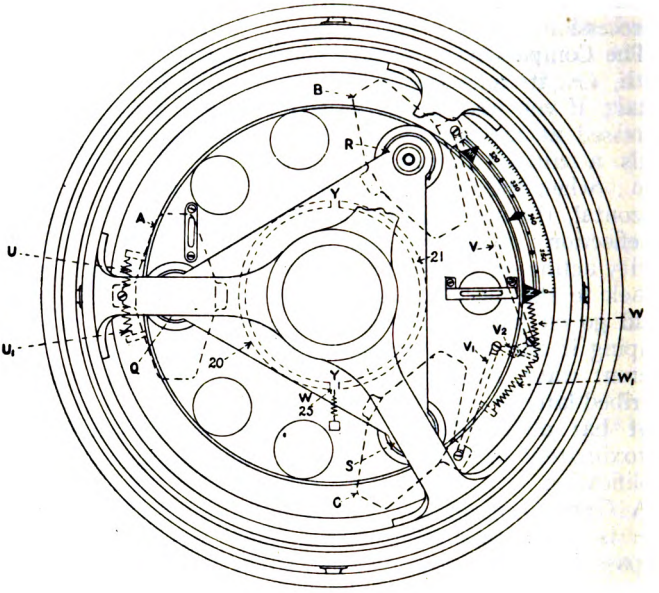
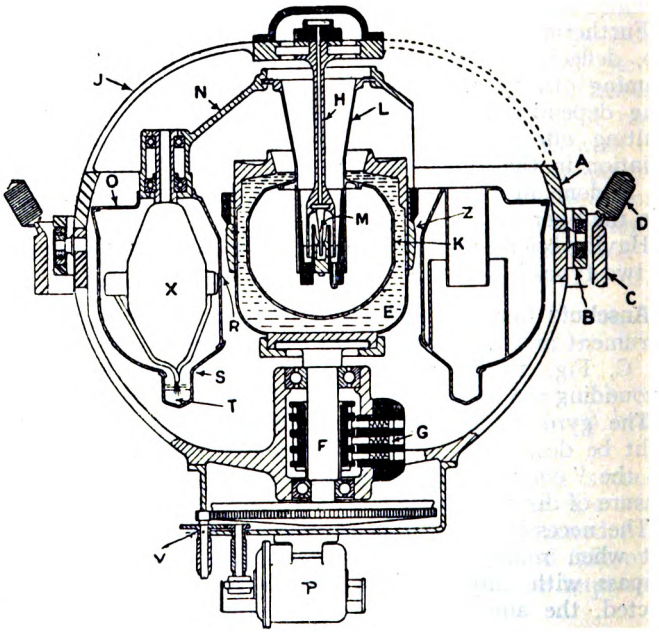


Fig. 2.



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closeness or synchronising of the period of roll and the period of the instrument.

Surrounding the gyros (X) Fig. 2, and below the card, is a casing (R) the bottom of which is divided into compartments (S), connected together by very fine tubes; the compartments are filled with oil which also supplies the gyro bearings as shown at (T), these compartments are the means used for damping the oscillation of the compass already mentioned, on the principle of rolling tanks in ships.

The whole of this part of the apparatus is mounted on a float (K) which is supported in the mercury bowl (E).

Surrounding the outside of the bowl and insulated from it is a conductor (Z), divided into two halves, separated from each other by slots three-sixteenths of an inch wide (Y) Fig. 1. Fitted into the card is a small ball contact (W) Fig. 1, which drops into either of the slots (Y).

The bowl in its turn is supported in a frame (A) and is free to revolve in it on its spindle (F). To the bottom of the frame (A), which is slung in gymbals, is attached a small motor (P) geared into the bottom of the spindle (F) by means of wheels (V).

The other parts of the equipment are as follows:—

(1) Motor Generator.
(2) Reversible Motor.
(3) Relay.
(4) Receiver Compasses.

The operation of the compass is as follows:—

On alteration of course, the ball contact (W), Fig. 1, touches one side or other of the slot (Y), according to the direction of alteration; this completes the circuit with one half of the conductor (Z), and allows current to flow to one side of the relay, the contact here being made allows current to flow to the reversible motor, turning it in the required direction; this in its turn by means of its commutator and series of brushes provides current to the Azimuth Motor (P) and all Receivers; the current to the Azimuth Motor causes it to turn the bowl (E) so as to follow up the ball contact (W), and in reality the ball remains in the slot.

The Sperry Compass.—The main or "directive gyro" wheel is mounted on its axis (A) in the casing (B), which is pivoted on the horizontal axis (C) through its centre of gravity, and carried in the vertical ring (D). The vertical ring (D) is suspended by a torsionless strand (E) guided by bearings (F) so as to allow a free oscillation of limited amount about its vertical axis within the frame or "phantom" (G).

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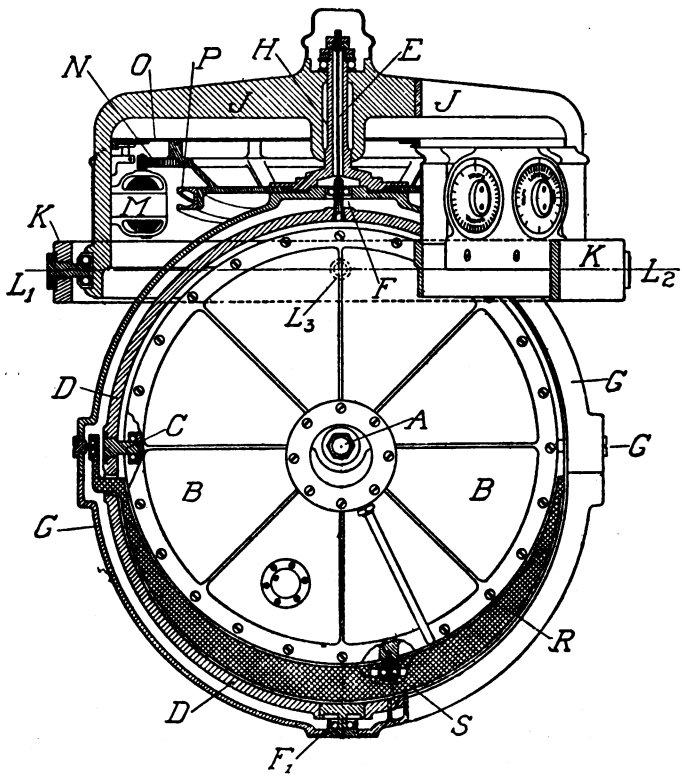
Fig. 3.



The phantom has a hollow stem (H) attached to its upper part, the top of which is flanged. This stem and phantom ring to which the compass card is attached are free to revolve over ball bearings carried in the centre of the frame (J) which is mounted in gymbals.

The frame (J) carries the follow up or Azimuth motor (M) driving a master gear (N) on the outer rim of the compass card, whereby this and the phantom ring (G) is driven in azimuth to respond to any movement of the ring (D) holding the gyro wheel.

This ring (D) is provided with electrical trolley contacts, which co-operate with fixed contacts on the phantom (G) (inked in on diagram), and these control the motor (M).

The damping is carried out by means of the weight or "bail" (R); pivoted to the phantom (G) it passes through the vertical ring (D) without touching it, and is secured to the casing (B) slightly eccentrically to the vertical axis at the point (S), the amount of the eccentricity is calculated so as to effect the necessary damping.

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The correction device consists of a tilted ring (P) attached to the phantom below the card, in the grooved rim of which an arm travels; as the ship alters course, this arm is turned up or down by the inclined ring and communicates its movement through the correcting mechanism for latitude and speed, the dials of which are set, to the lubber point, moving it the required amount.

Other parts of the equipment are as follows :—

(1) Relay.
(2) Transmitter, worked off the toothed rim of the compass card and which operates all the Receiver Compasses.
(3) Generator.
(4) Accumulator Battery, 20 volt, for operating the follow up and transmission systems when power fails.
(5) Switch board and alarm bell.
(6) Receiver Compasses.

The operation of the compass is as follows :—

On alteration of course, the trolley contacts move to one side or other of the fixed contacts, according to the direction of alteration, and energise the relay; this allows current to flow to the Azimuth Motor, and it in its turn works the whole phantom ring and card so as to retain their relative position with the vertical ring (D) carrying the Gyro, at the same time the transmitter is allowing current to flow to the receivers making them follow up exactly the movement of the Master Compass.

A small compensating Gyro, not shown in Figure, is carried on an arm the top of which is attached to the centre of the casing (B) and the bottom to the bail (R), being free to move on a bracket in an E. and W. direction on it.

This small gyro controls the main gyro through the bail (R) when rolling and pitching on inter-cardinal points.

The main difference between the two types lies in their mode of suspension, also in the Anschutz Compass the Gyros are attached to the card, whereas in the Sperry the card is quite separate from the Gyros.

Other methods of suspension have been and are being tried, such as magnetic and air, but so far there are no practical compasses on the market embodying these methods.

The advantages of the Gyro Compasses are as follows :—

(1) The Master Compass is placed below the water line and thereby is more or less immune from gun-fire, the receiver compasses being placed as desired.

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(2) It responds *at once* to the movement of the ship in azimuth, and therefore ensures better steering.

(3) The directive force is considerably greater than that of a magnetic compass, that of the Sperry being nearly 300 times as great.

(4) It can be utilised in connection with Fire Control Apparatus and Torpedo Directors, also for adjusting torpedo gyros at sea.

(5) It is unaffected by magnetic or electrical disturbances.

It is considered, however, that the gyro compass will never be able to entirely replace the magnetic compass; the directive force of the latter never fails, whereas that of the gyro compass may, or it may become otherwise defective as all mechanical and electrical instruments are liable to.

For fuller details on this subject, reference should be made to the Manual of Navigation.

Standard Compass.

The principal compass of a ship, generally placed on the fore upper bridge where a good all-round view can be obtained, is called the "standard compass," the compasses at the steering positions being called steering compasses.

With standard compasses an additional instrument called an "azimuth mirror" is supplied. It rests on top of the compass bowl, and can be turned round in any direction, and is used for reading the direction of any object from the compass card.

The direction of any object from the compass as read from the compass card is called the "bearing" of the object.

Before being issued to the Service all compasses are carefully examined and tested at the Compass Observatory, Royal Victoria Yard, Deptford.

They are supplied in boxes, and in the case of Kelvin's compasses every bowl is supplied with two cards, each in its own separate box with spare caps and pivots; these card boxes are marked on the outside N. and S., corresponding to the position of the N. and S. ends of the card they contain. In stowing these boxes care should be taken that the N. of one box is in the same direction as the S. of the second. All magnets should when stowed away be placed with oppositely marked ends together; they are painted half red and half blue, the red indicating that end which is called the north end of the magnet, and blue the south end.

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Boats' Compasses.

For use in boats a special "boat's compass" is supplied; it is a liquid compass, and the card is marked in points, half and quarter points; the same as a ship's compass, but the degrees are omitted.

The compass bowl is fitted by means of a gimbal ring into a small portable binnacle, which is made in two parts, the upper part brass and the lower part wood, secured together by screws. A handle for carrying the binnacle is fitted at the top.

In the upper part are three glass windows, one at each side and one at the after side; a candle lamp fits into sliding grooves at either side windows, so that the light is shed on to the compass bowl through the window, a sliding shutter being supplied to fit over the side window when not used for the lamps; there is also a small round window in the top of the binnacle, and a brass cap to go over it and protect it from damage, or to cover it at night.

When using the compass in daytime all the windows should be uncovered, the lamp being then stowed in the sliding fitting at the fore side of the binnacle.

The lower or wooden part of the binnacle has a door at the after side, and on the inside of the door is pasted a copy of instructions for use of the compass. Inside the binnacle is an arrangement for "locking" the gimbal ring and compass bowl, thus preventing the bowl swinging about when the binnacle is carried by hand from place to place.

The bowl should always be "locked" when carrying the compass.

Inside the binnacle there is also a small brass cylinder for stowing a spare candle for the lamp.

No arrangements are made for adjusting boats' compasses, and when using the compass in a boat it should be placed well away from any of the iron fittings of the boat, with its lubber's point in line with the boat's head.

NOTE.—The binnacles of boats' compasses supplied to destroyers and torpedo boats are made entirely of brass or copper, the general arrangements being the same as above described.

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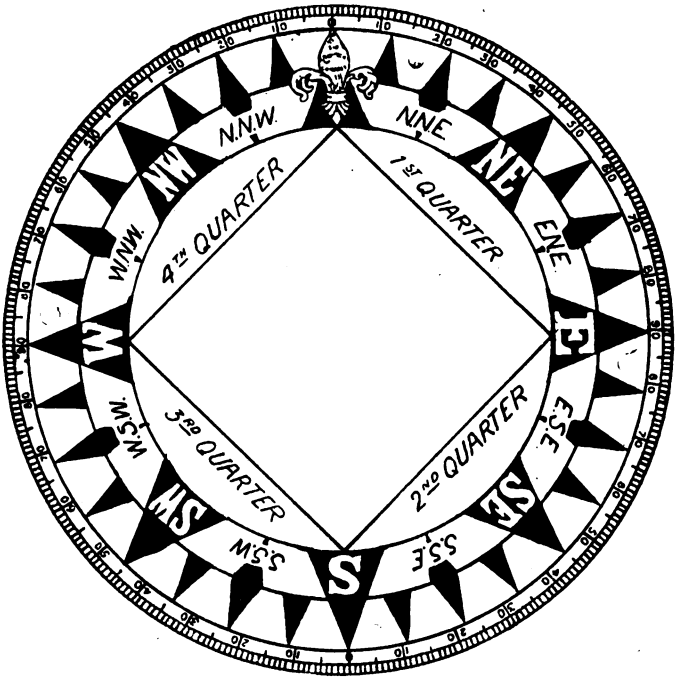
Compass Card.
Marked in Points and Degrees.



3rd Quarter. S.	*4th Quarter.* W.	*1st Quarter.* N.	*2nd Quarter.* E.
S. by W.	W. by N.	N. by E.	E. by S.
S.S.W.	W.N.W.	N.N.E.	E.S.E.
S.W. by S.	N.W. by W.	N.E. by N.	S.E. by E.
S.W.	N.W.	N.E.	S.E.
S.W. by W.	N.W. by N.	N.E. by E.	S.E. by S.
W.S.W.	N.N.W.	E.N.E.	S.S.E.
W. by S.	N. by W.	E. by N.	S. by E.
W.	N.	E.	S.

There are 32 points in the compass. The way to learn the name of each point is as follows:—

4 cardinal or principal points—N., S., E., W.

4 half-cardinal or quadrantal—N.E., N.W., S.E., S.W.

The above principal points have their names painted on them. From these you get the names of all the other points.

8 intermediate or three-letter points. They are the centre points between each cardinal and half-cardinal. Join the name of the cardinal to that of the half-cardinal and you have the intermediate point. Thus intermediate point between N. and N.E. is N.N.E. Between N.E. and E. is E.N.E. Similarly the others are E.S.E., S.S.E., S.S.W., W.S.W., W.N.W., and N.N.W.

16 "by" points. They are the points on either side of a cardinal or half-cardinal and take their name "by" the next cardinal. Thus points each side of N. are N. by E. and N. by W.; of N.E. are N.E. by N. and N.E. by E.

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Compass Card.

Marked in Points, Half Points, Quarter Points, and Degrees.

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S.	
Points, Half-points, and Quarter-points.	Approximate position in Degrees to nearest Half-degree.
S. ¼ W.	S. 3° W.
S. ½ W.	S. 5½° W.
S. ¾ W.	S. 8½° W.
S. by W.	S. 11° W.
S. by W. ¼ W.	S. 14° W.
S. by W. ½ W.	S. 17° W.
S. by W. ¾ W.	S. 19½° W.
S.S.W.	S. 22½° W.
S.S.W. ¼ W.	S. 25⅝° W.
S.S.W. ½ W.	S. 28° W.
S.S.W. ¾ W.	S. 31° W.
S.W. by S.	S. 33¾° W.
S.W. ¾ S.	S. 36½° W.
S.W. ½ S.	S. 39⅜° W.
S.W. ¼ S.	S. 42° W.
S.W.	S. 45° W.
S.W. ¼ W.	S. 48° W.
S.W. ½ W.	S. 50¼° W.
S.W. ¾ W.	S. 53½° W.
S.W. by W.	S. 56° W.
S.W. by W. ¼ W.	S. 59° W.
S.W. by W. ½ W.	S. 62° W.
S.W. by W. ¾ W.	S. 64½° W.
W.S.W.	S. 67½° W.
W. by S. ¾ S.	S. 70½° W.
W. by S. ½ S.	S. 73° W.
W. by S. ¼ S.	S. 76° W.
W. by S.	S. 78½° W.
W. ¾ S.	S. 81½° W.
W. ½ S.	S. 84⅜° W.
W. ¼ S.	S. 87° W.
W.	

W.	
Points, Half-points, and Quarter-points.	Approximate position in Degrees to nearest Half-degree.
W. ¼ N.	N. 87° W.
W. ½ N.	N. 84½° W.
W. ¾ N.	N. 81½° W.
W. by N.	N. 78½° W.
W. by N. ¼ N.	N. 76° W.
W. by N. ½ N.	N. 73° W.
W. by N. ¾ N.	N. 70½° W.
W.N.W.	N. 67½° W.
N.W. by W. ¾ W.	N. 64⅜° W.
N.W. by W. ½ W.	N. 62° W.
N.W. by W. ¼ W.	N. 59° W.
N.W. by W.	N. 56° W.
N.W. ¾ W.	N. 53½° W.
N.W. ½ W.	N. 50¼° W.
N.W. ¼ W.	N. 48° W.
N.W.	N. 45° W.
N.W. ¼ N.	N. 42° W.
N.W. ½ N.	N. 39½° W.
N.W. ¾ N.	N. 36½° W.
N.W. by N.	N. 33¾° W.
N.N.W. ¾ W.	N. 31° W.
N.N.W. ½ W.	N. 28° W.
N.N.W. ¼ W.	N. 25½° W.
N.N.W.	N. 22½° W.
N. by W. ¾ W.	N. 19½° W.
N. by W. ½ W.	N. 17° W.
N. by W. ¼ W.	N. 14° W.
N. by W.	N. 11° W.
N. ¾ W.	N. 8½° W.
N. ½ W.	N. 5½° W.
N. ¼ W.	N. 3° W.
N.	

N.	
Points, Half-points, and Quarter-points.	Approximate position in Degrees to nearest Half-degree.
N. ¼ E.	N. 3° E.
N. ½ E.	N. 5½° E.
N. ¾ E.	N. 8½° E.
N. by E.	N. 11° E.
N. by E. ¼ E.	N. 14° E.
N. by E. ½ E.	N. 17° E.
N. by E. ¾ E.	N. 19½° E.
N.N.E.	N. 22½° E.
N.N.E. ¼ E.	N. 25⅝° E.
N.N.E. ½ E.	N. 28° E.
N.N.E. ¾ E.	N. 31° E.
N.E. by N.	N. 33¾° E.
N.E. ¾ N.	N. 36½° E.
N.E. ½ N.	N. 39⅜° E.
N.E. ¼ N.	N. 42° E.
N.E.	N. 45° E.
N.E. ¼ E.	N. 48° E.
N.E. ½ E.	N. 50¼° E.
N.E. ¾ E.	N. 53½° E.
N.E. by E.	N. 56° E.
N.E. by E. ¼ E.	N. 59° E.
N.E. by E. ½ E.	N. 62° E.
N.E. by E. ¾ E.	N. 64½° E.
E.N.E.	N. 67½° E.
E. by N. ¾ N.	N. 70½° E.
E. by N. ½ N.	N. 73° E.
E. by N. ¼ N.	N. 76° E.
E. by N.	N. 78½° E.
E. ¾ N.	N. 81½° E.
E. ½ N.	N. 84⅜° E.
E. ¼ N.	N. 87° E.
E.	

E.	
Points, Half-points, and Quarter-points.	Approximate position in Degrees to nearest Half-degree.
E. ¼ S.	S. 87° E.
E. ½ S.	S. 84½° E.
E. ¾ S.	S. 81½° E.
E. by S.	S. 78½° E.
E. by S. ¼ S.	S. 76° E.
E. by S. ½ S.	S. 73° E.
E. by S. ¾ S.	S. 70½° E.
E.S.E.	S. 67½° E.
S.E. by E. ¾ E.	S. 64⅜° E.
S.E. by E. ½ E.	S. 62° E.
S.E. by E. ¼ E.	S. 59° E.
S.E. by E.	S. 56° E.
S.E. ¾ E.	S. 53½° E.
S.E. ½ E.	S. 50¼° E.
S.E. ¼ E.	S. 48° E.
S.E.	S. 45° E.
S.E. ¼ S.	S. 42° E.
S.E. ½ S.	S. 39½° E.
S.E. ¾ S.	S. 36½° E.
S.E. by S.	S. 33¾° E.
S.S.E. ¾ E.	S. 31° E.
S.S.E. ½ E.	S. 28° E.
S.S.E. ¼ E.	S. 25½° E.
S.S.E.	S. 22½° E.
S. by E. ¾ E.	S. 19½° E.
S. by E. ½ E.	S. 17° E.
S. by E. ¼ E.	S. 14° E.
S. by E.	S. 11° E.
S. ¾ E.	S. 8½° E.
S. ½ E.	S. 5½° E.
S. ¼ E.	S. 3° E.
S.	

The compass is divided into 32 points, 32 half-points, 64 quarter-points, 360 degrees.
1 point is divided thus: ¼ ½ ¾ and the whole point; and contains 11° 15'.
Each quarter of the compass has 8 points or 90 degrees.
It is customary to steer to the nearest degree

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RULES.

Never read from a point that begins and ends with the same letter (those shown blank).

Read from each side of every cardinal and half-cardinal.

Never read more than once from any other point.

When the point that you read from is behind you, commence with a ¼ point; when it is in front of you, commence with a ½ point.

To read a compass by degrees, always read from N. or S. to E. or W.—thus: N.E. would be N. 45° E., S.E. would be S. 45° E., S.W. would be S. 45° W., N.W. would be N. 45° W.

To read the compass, always commence with the ¼ point and work towards the next nearest cardinal—thus: N. ¼ E., N. ½ E., N. ¾ E., except when you come to a point that, by your rule, you cannot read from, then drop it, go to the next point and commence a ¼ point with it. Thus, by your rule, you cannot read from E.N.E. Drop it. Go to E. by N. and commence E. by N. ¼ N., E. by N. ½ N., E. by N. ¾ N.

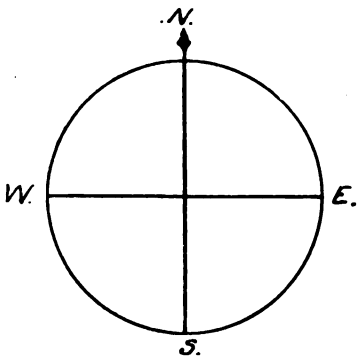
Hints on Learning and Teaching the Compass.

These hints are more especially for those who find a difficulty in learning the compass.

The compass must not be looked on as something to be overcome by an effort of memory, but should be taught and learned on common-sense lines.

Every boy knows that there are four points called North, South, East, and West, and that North is opposite to South, and East opposite to West. He also knows from the weathercock that, if looking North, East is on the right hand and West on the left; and by looking at South, East is on the left and West on the right hand. These four points are called cardinal points (Fig. 1). It

Fig. 1.



Cardinal points.

may also have been noticed that a division was marked on the weathercocks between these cardinal points, such as North-east, North-west, South-east, and South-west.

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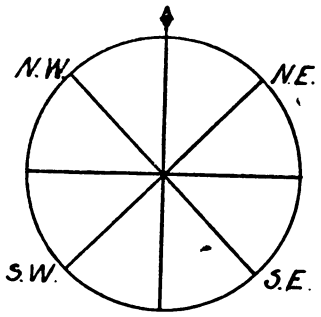
It would naturally be supposed that North-east was midway between North and East, and so on for the others These are called half-cardinal points (Fig. 2); there are,

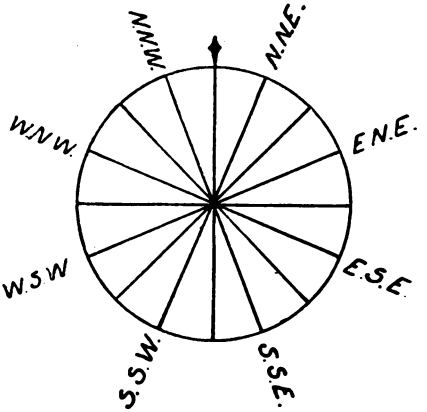
Fig. 2.



Half-cardinal points.

therefore, eight points in the compass known already. The next point to learn is that which is half-way between the cardinal and half-cardinal points, and it is evident that there must be as many of these points as there are cardinal and half-cardinal points together, that is to say, eight. These are known as intermediate or three-letter points (Fig. 3). Starting from North towards East, the first one of these

Fig. 3.



Intermediate or three-letter points.

is midway between North and North-east, and is called North-north-east, that is, two Norths to one East, as it is nearer to North than to East. The next one is midway

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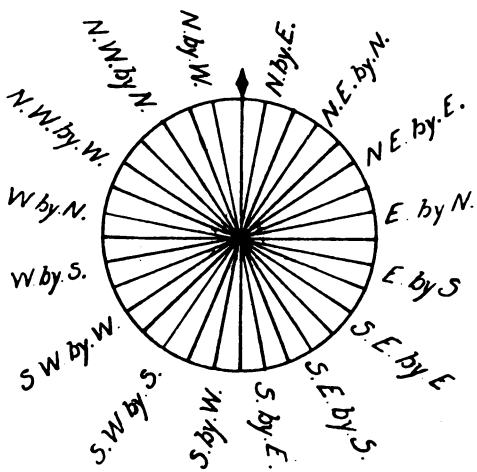
between North-east and East, and is known as East-north-east, that is, two Easts to one North, as it is nearer to East than to North. (*It must be remembered that when an intermediate point begins with East or West the two Easts or two Wests never come together.*) Points are written with the first letter of their name, thus:—North-north-east is written N.N.E, and East-north-east E.N.E., and so on. Now, to continue round the compass, towards south, the next intermediate point we come to is midway between East and South-east, and, by the same rule, as it is nearer to East than to South, it must have two Easts, and is, therefore, East-south-east, or E.S.E., and so on; S.S.E., midway between South-east and South; and round the remaining half of the compass, S.S.W., midway between South and South-West; W.S.W., midway between South-west and West; W.N.W., midway between West and North-West; and N.N.W., midway between North-West and North. This completes the eight intermediate points, so that 16 points of the compass are known.

The remaining 16 points are those midway between the cardinal and intermediate points, and midway between the intermediate and half-cardinal points. These are known as the "By-points" (Fig. 4), because they all have

Fig. 4.



By-points.

the word "By" in them. As there is one between each of the 16 points already learnt, it follows that there must be 16 of them. Starting from North to the right, the first intermediate point arrived at is N.N.E. and the point mid-

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way between North and N.N.E. is N. by E.; so that the two points starting from North to the right are N. by E. and N.N.E., The point midway between N.N.E. and N.E. (starting from the half-cardinal) is N.E. by N., and after N.E. the next point to the right will be N.E. by E.; then another intermediate point, E.N.E.; then E. by N. All the points between North and East have now been named, in other words, "the compass has been boxed" from North to East. Continuing, working round the compass towards South, the next point from East will be E. by S., then E.S.E., then S.E. by E., then S.E., and so on, as follows; S.E. by S., S.S.E., S. by E., South, S. by W., S.S.W., S.W. by S., S.W., S.W. by W., W.S.W., W. by S., West, W. by N., W.N.W., N.W. by W., N.W., N.W. by N., N.N.W., N. by W,. North.

The compass has now been completely boxed from North to the right, through East, South, and West, back to North.

It should now be practised starting from North to the left, through West, South, and East, back to North, and also starting from any cardinal or half-cardinal point, either to the right or to the left, not trying to do it from memory, but *thinking* why each point is so named; and after a short practice it will become quite mechanical and the point will come by instinct.

Having mastered the points, the next thing is to learn the half and quarter points and degrees.

A compass being a complete circle contains 360 degrees. From North to East is a quarter of a circle, and therefore contains 90 degrees; from East to South is another 90 degrees, therefore from North to South is 180 degrees, which is half the circle. It is important to remember that all opposite points are 180 degrees apart. N.E. being midway between North and East, it follows that from North to N.E. is 45 degrees, and from N.E. to East is 45 degrees. N.N.E. being midway between North and East is 22½ degrees, and as North by East is midway between North and N.N.E., N. by E. is 11¼ degrees from North; thus, it will be seen that each point of the compass is 11¼ degrees.

With the present compasses and with mechanical steering gear it is quite possible to steer a ship to a degree; but formerly, when the compasses were not so good and ships were steered by hand power, steering could not be relied upon to a degree, and ships were commonly steered to the nearest quarter of a point, and the points were therefore divided into quarters. (Fig. 5.)

Starting from North towards East, the first quarter point is N. ¼ E., then N. ½ E., N. ¾ E., and N. by E.; the

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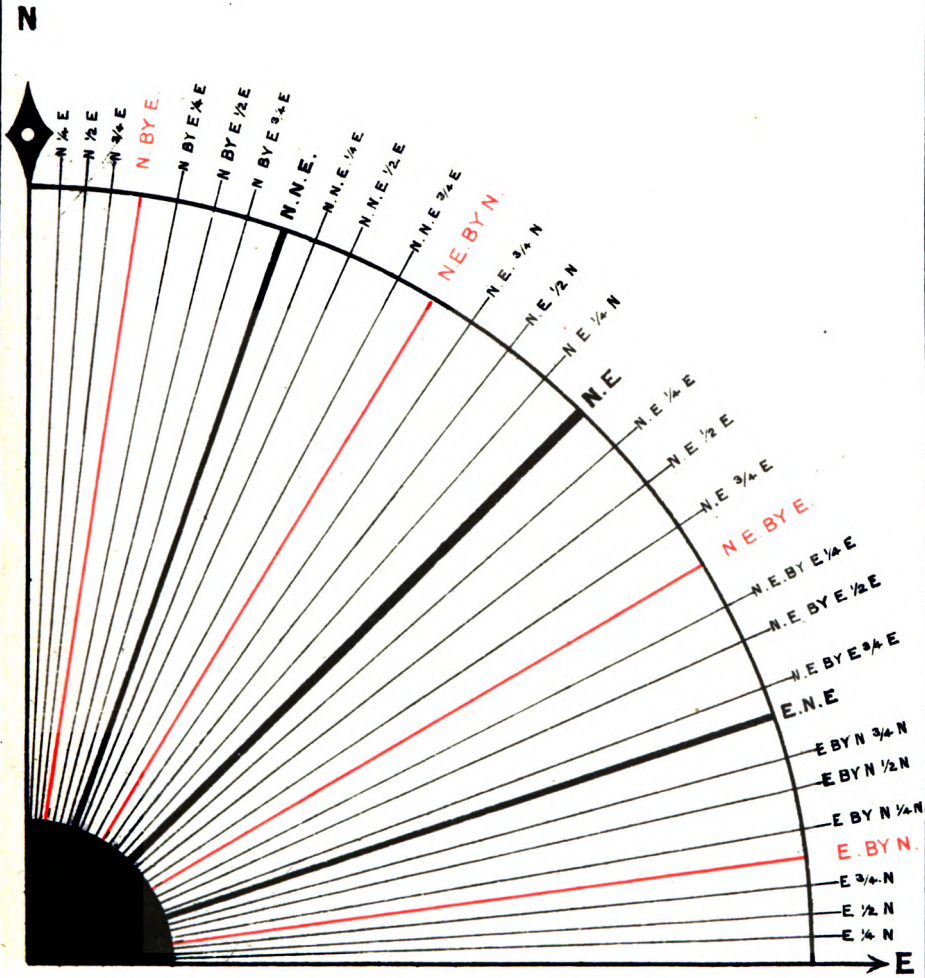

FIG. 5.

HALF AND QUARTER POINTS.

1880

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next quarter from N. by E. towards East is N. by E. ¼ E.; then N. by E. ½ E., N. by E. ¾ E., then N.N.E. Similarly from N.N.E. it will be N.N.E. ¼ E., N.N.E. ½ E., N.N.E. ¾ E., then N.E. by N.

Now the next quarter point from N.E. by N. towards East is *not* called "N.E. by N. ¼ E.," but is reckoned from N.E., and is therefore N.E. ¾ N.; then comes N.E. ½ N. N.E. ¼ N., then N.E. Continuing towards East we get N.E. ¼ E., N.E. ½ E., N.E. ¾ E., N.E. by E.; then N.E. by E., ¼ E., N.E. by E. ½ E., N.E. by E. ¾ E., then E.N.E. Now the counting starts from East, so that the next quarter point from E.N.E. towards East is E. by N. ¾ N., then E. by N. ½ N., E. by N. ¼ N., then E. by N. Still working towards East, the next quarter point is E. ¾ N., then E. ½ N., E. ¼ N., East.

It is precisely similar for the other three quadrants of the circle, remembering that in starting to work from one cardinal to another, in working back from the half-cardinal the ¾ comes first; thus in working from East to South, you continue straight on to E.S.E. as follows:—E. ¼ S., E. ½ S., E. ¾ S., E. by S., E. by S. ¼ S., E. by S. ½ S., E. by S. ¾ S., E.S.E.; now you work back and the next is S.E. by E. ¾ E., S.E. by E. ½ E., S.E. by E. ¼ E., S.E. by E.; then S.E. ¾ E., S.E. ½ E., S.E. ¼ E., S.E. Again after S.E. by S. it starts S.S.E. ¾ E., S.S.E. ½ E., S.S.E. ¼ E., S.S.E. Then commence with the cardinal, and the next quarter point is S. by E. ¾ E., S. by E. ½ E., S. by E. ¼ E., S. by E., then S. ¾ E., S. ½ E., S. ¼ E., and South.

This should be practised until the learner can start from any point in either direction.

Points are always reckoned from North and South towards East and West, thus:—

N. by E., N. by W., S. by E., S. by W., are all one point.

N.N.E., N.N.W., S.S.E., S.S.W., are two points.

N.E. by N., N.W. by N., S.E. by E., S.W. by W. are three points.

N.E., N.W., S.E., S.W. are four points.

N.E. by E., N.W. by W., S.E. by E., S.W. by W., are five points.

E.N.E., E.S.E., W.N.W., W.S.W., are six points.

E. by N., E. by S., W. by N., W. by S., are seven points.

East and West are eight points.

The learning of the opposite points is quite simple if it is borne in mind that North is opposite to South, and East opposite to West, and that two or three of

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these letters added together represent all the points of the compass. For example :—

E.N.E. is the opposite point to W.S.W.
S.S.E. is the opposite point to N.N.W.
N.E. is the opposite point to S.W.
N.N.E. ½ E. is the opposite point to S.S.W. ½ W.
N. ¼ E. is the opposite point to S. ¼ W.,

and so on to any point of the compass substituting South for North and West for East.

Remarks on Steering.

One of the most important duties of a seaman is to be able to steer efficiently and well. This art can only be acquired by constant practice and careful attention to details. The various orders and terms used in steering apply equally to the largest or smallest vessel or boat, whether under mechanical propulsion, oars or sail.

In early days vessels were steered by means of a board hung on one side of the stern post, called a "steer-board" —hence the name "starboard" as that side of the ship on which the board was placed. Later a rudder was hung on the sternpost, and moved by the tiller (or helm), a long piece of wood secured to the rudder head, projecting forward in the fore and aft line, and moved by hand. Subsequently, owing to the inconvenient length of the tiller, an alternative method, using what is termed a "yoke," was employed. The "yoke" consisted of a piece of wood or metal placed athwartships on the rudder head, worked by lines secured to its extremities, called "yoke-lines."

These simple fundamental appliances still form the groundwork on which the more elaborate mechanical steering arrangements of the present day are based.

The Tiller.—The simplest form of tiller is of wood or metal, and is used for steering launches, pinnaces, cutters, and the smaller steamboats. It is moved by hand. Larger forms of tillers are worked by means of tiller ropes or chains, leading from the fore end of the tiller to the vessel's side, and from thence to the barrel of a steering wheel, or else, by suitable connections, to an engine operated by means of shafting, or other device, from a small wheel.

The Yoke.—The simplest form of yoke is of wood or steel, and is used for steering gigs, whalers, and dinghies (in which a tiller would be inconveniently long), and is moved by means of yoke-lines connected to the extremities of the yoke. Twiddling lines are sometimes used in connection with the yoke-lines to give increased power to

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move the rudder. In larger vessels, suitable mechanical arrangements are fitted which enable the yoke to be moved by means of an engine from a small wheel. All H.M. ships and many of the larger steamboats are steered from a wheel.

The "*helm*" is the term used to indicate the "*tiller*."

It is of the utmost importance to remember that all orders given with regard to the helm refer to the *tiller*, and it is quite immaterial whether the vessel concerned is fitted with a tiller or a yoke, or whether these are actuated by hand or mechanical power, and worked by a steering wheel or not. As the tiller was the earliest method used for moving the rudder, the orders, applicable to all systems, still refer to it.

With hand wheels, that is when the tiller ropes are brought direct to the barrel of the wheel, the maximum number of turns of the wheel to give the maximum amount of helm is about four, and with craft so fitted it is customary to designate the amount of helm to be given by ordering the requisite number of turns to be given to the wheel; thus, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1 turn, &c., until the maximum number is reached. With wheels actuating some form of machine many more turns can be given to the wheel, and in such cases it is customary to have an indicator, with an arc graduated to 35°, with a pointer, the position of which corresponds to the position of the helm. With steering wheels so fitted, and they are general in all modern vessels, the amount of helm is designated by numerals representing the number of degrees the helm is to be moved; thus, 5, 10, 15, &c., until the maximum angle to which the helm can be moved in H.M. ships, viz., 35°, is reached.

Having briefly described the different appliances used for moving the rudder, it is necessary to study the various orders given to the helmsman, the manner in which they are carried out, and what the results should be.

For convenience we will divide the subject into two parts: (I) dealing with the steering of steam or power-propelled vessels and boats. (II) Dealing with sailing vessels and boats.

(I) may be divided into two classes of orders (*a*) and (*b*):—

(*a*) Giving directions how the helm is to be placed.
(*b*) Giving directions as to the course to be steered.

Speaking generally, (*a*) is used when the vessel is being "conned" by an officer or other person, and is not being steered by compass, or in a definite direction.

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"PORT."

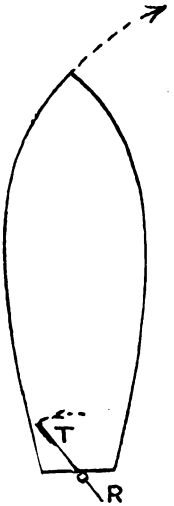

Fig. 1 A.

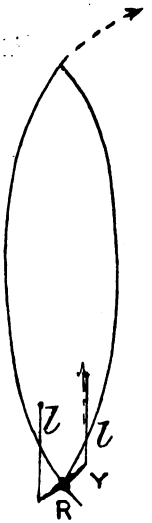

Fig. 1 B.

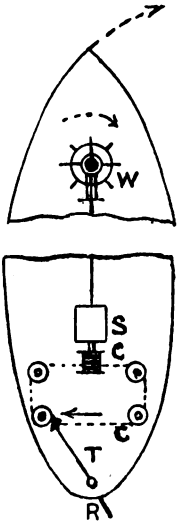

Fig. 1 C.

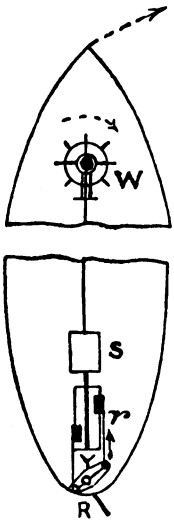

Fig. 1 D.

"STARBOARD."

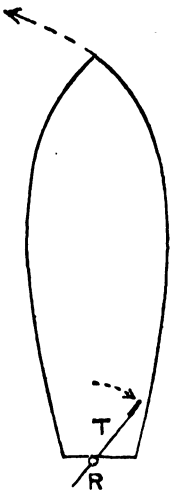

Fig. 2 A.

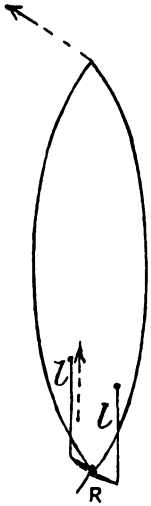

Fig. 2 B.

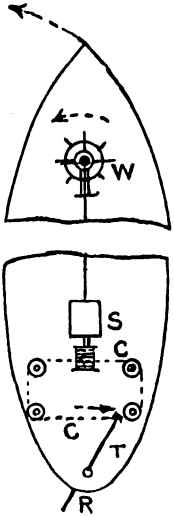

Fig. 2 C.

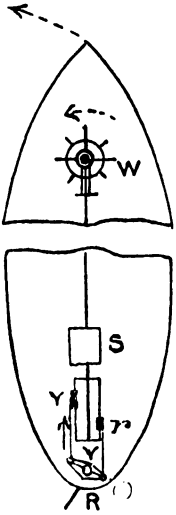

Fig. 2 D.

R = Rudder.
T = Tiller.
Y = Yoke.

l = Yoke Lines.
r = Yoke Rods.
W = Wheel.

C = Wheel Chains or Ropes.
S = Steering Engine.

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In the accompanying figures—

1A, 2A } represent a vessel steered by a tiller.

1B, 2B } represent a vessel steered by a yoke or yoke-line.

1C, 2C { represent a vessel steered by a wheel (which by means of ropes or a steering engine moves a tiller).

1D, 2D { represent a vessel steered by a wheel (which by means of ropes or a steering engine moves a yoke).

As all orders given with regard to the helm refer to the tiller it follows that if the order "Port" is given it means that the tiller is to be moved to the port side of the vessel, and if the order "Starboard" is given, the tiller is to be moved to the starboard side of the vessel.

As a general rule when the order "Port" or "Starboard" is given it should be followed by the amount of helm it is desired to give.

Figures 1A, 1B, 1C and 1D illustrate the order "Port."

In Figure 1A the tiller has been moved to *port*.

In Figure 1B the *starboard* yoke line has been pulled.

In Figure 1C the wheel has been turned to *starboard*, putting the tiller to port.

In Figure 1D the wheel has been turned to *starboard* pulling the starboard yoke rod.

In each of these four figures the rudder is turned to starboard and the vessel, if she had headway, would turn to starboard. Thus, at the order "Port," the tiller is moved to port, but the rudder, wheel, yoke, and ship's head go to starboard.

Figures 2A, 2B, 2C and 2D illustrate the order "Starboard."

In Figure 2A the tiller has been put to *starboard*.

In Figures 2B, the *port* yoke line has been pulled.

In Figure 2C, the wheel has been turned to *port* putting the tiller to starboard.

In Figure 2D, the wheel has been turned to *port* pulling the port yoke rod.

In each of these four figures the rudder is turned to port, and the vessel, if she had headway, would turn to port. Thus, at the order "Starboard," the tiller is moved to starboard, but the rudder, wheel, yoke, and ship's head go to port.

It will be observed that the upper portion of the steering wheel always moves in the same direction as the ship's head.

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It is very important that the foregoing orders with their results should be clearly understood.

The usual orders, with their results, are given in Table I.

TABLE I.

P. = Port. S. = Starboard.

—	Order.	Tiller to be put to	Yoke Line or Rod to be pulled	Wheel to be turned to	Rudder will go to	Direction to which Ship's Head will turn	Remarks.
1	Port – –	P.	S.	S.	S.	S.	Vide figures 1A, B, C, D and 2A, B, C, D.
2	Starboard –	S.	P.	P.	P.	P.	An indefinite amount of helm.
3	Hard a' Port–	P.	S.	S.	S.	S.	The maximum amount of helm to be given.
4	Hard a' Starboard.	S.	P.	P.	P.	P.	
5	Port 5-10-20, &c.	P.	S.	S.	S.	S.	Terms usually employed when a vessel is steered by a wheel fitted with helm indicators. Not applicable to vessels without indicators or to boats.
6	Starboard 5-10-20, &c.	S.	P.	P.	P.	P.	
7	Port ¼-½-2 turns, &c.	P.	S.	S.	S.	S.	Terms usually employed when a vessel or boat is steered by a wheel, but not fitted with helm indicators. Should *not* be used in vessels with indicators.
8	Starboard ¼-½-2 turns, &c.	S.	P.	P.	P.	P.	

Orders 1 to 4 are illustrated by the Figures. Great care should be exercised in orders 5 and 6 that the amount of helm to be used should be given as a numeral *only*, avoiding the use of the word "degrees," *e.g.*, "Port 15," *not* "Port 15 degrees," as the latter term would mean an alteration of course.

When it is desired to give a course to the helmsman, the order "Steady" should be given; this order means "Keep the ship's head in the direction it was in at the moment it was given." At the order "Steady," the helmsman should give the necessary helm to keep the ship's head in that direction, and should the ship have swung beyond it, to bring her back to it.

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The order "Steady" does not mean that the helm is to be put amidships. If it is desired to put the helm amidships, the order "'Midships" should be given.

"Steady the helm" is a contradictory order, and should never be used.

When altering course the orders to the helmsman should be so regulated that the ship's head is brought nearly to rest before the order "Steady" is given. For example:—"Hard a port," "Ease to 15," "'Midships," "Starboard 10," "Steady."

Many pilots, especially in commercial ports, will give the order "Steady" while the helm is hard over. This is undesirable, because the ship's head must necessarily swing beyond the course it is desired to steer, and it is also likely to confuse the helmsman.

The word "Course" is sometimes used instead of "Steady," but it is quite wrong and should not be done.

In ships that continue to swing much after the helm is put amidships, helm should be given to "meet her" *before* the desired point is reached.

The helmsman should stand immediately abaft the steering compass in order that he may see straight into it, as looking into it from one side, the degree which appears to be opposite the "Lubber's Point" is not really so, and is not, therefore, the course to be steered.

If not steering by compass, the helmsman should observe some object immediately ahead to steer for.

Whenever an order is received by the helmsman it should invariably be repeated by him in exactly the same words, and when the purport has been carried out, it should be reported.

For example:—

Order.	Reply.	Purport carried out.
Hard a port	Hard a port	Helm's hard a port.
Ease to 15	Ease to 15	Eased to 15.
'Midships	'Midships	Helm's amidships.
Starboard 10	Starboard 10	10 of starboard.
Steady	Steady	Steady (when the ship is on the course).

(*b*) **Giving directions as to the course to be steered.**

These orders are used when the vessel is being steered by compass, or heading in a certain direction, and it is desired to alter to another course or direction. In this case the officer or person conning orders either—

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(i) The general direction in which the helm is to be put, together with the amount the course is to be altered; or

(ii) The direction in which it is desired to steer, *i.e.*, the actual course by compass.

In both (i) and (ii) the necessary amount of helm is given by the helmsman to bring the vessel's head to the required direction, the amount being left to his judgment.

With regard to (i), the usual orders given are shown in Table II.

TABLE II.

P. = Port. S. = Starboard.

—	Order.	Tiller to be put to	Yoke Line or Rod to be pulled	Wheel to be turned to	Rudder will go to	Direction to which Ship's Head will turn.
1	Port ¼ point – –	P.	S.	S.	S.	Starboard to the amount ordered.
2	Starboard 1 point –	S.	P.	P.	P.	Port to the amount ordered.
3	Port 5 degrees –	P.	S.	S.	S.	Starboard the number of degrees ordered.
4	Starboard 10 degrees	S.	P.	P.	P.	Port the number of degrees ordered.

It will be noticed that there is a close resemblance between Tables I. and II., but it must be remembered that the first relates to the direction and amount the helm is to be moved, and the second to the direction in which the helm is to be moved and the amount the course is to be altered. This resemblance is especially close in Nos. 5 and 6, Table I., and Nos. 3 and 4, Table II., consequently it is undesirable to make use of orders similar to Nos. 3 and 4, Table II., as the "degrees of course" are liable to be mistaken for "degrees of helm," as in Nos. 5 and 6, Table I. It is therefore better to confine the orders to points, half points, and quarter points, as in Nos. 1 and 2, Table II. For example: "Starboard, one point"—"Steady"—"Port, a quarter of a point"—"Steady," &c. It is advisable to limit alterations by this method to small amounts, say, to one point (11 degrees). If larger alterations are required, the necessary directions should be given to the helmsman with regard to the helm to be used, and then to "Steady" on the new course.

The usual orders given with regard to (ii) and their results are given in Table III.

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TABLE III.

P. = Port. S. = Starboard.

—	Order.	Tiller to be put to	Yoke Line or Rod to be pulled	Wheel to be turned to	Rudder will go to	Direction to which Ship's Head will turn.
1	Alter course to Port.	S.	P.	P.	P.	To Port, using Starboard helm.
2	Alter course to Starboard.	P.	S.	S.	S.	To Starboard, using Port helm.
3	Steer more to Port.	S.	P.	P.	P.	To Port, using Starboard helm.
4	Steer more to Starboard.	P.	S.	S.	S.	To Starboard, using Port helm.
5	Steer course indicated (to Port).	S.	P.	P.	P.	To Port, using Starboard helm.
6	Steer course indicated (to Starboard).	P.	S.	S.	S.	To Starboard, using Port helm.

It will be observed that merely the direction in which to steer is given, the helmsman using the necessary amount of helm to carry out the order. Thus, in No. 1, the course is to be altered to port, and in order to do this the helm (*i.e.*, the tiller) must be moved to starboard, or the port yoke line pulled, or the wheel turned to port.

If steering by compass it is better to name the actual course it is desired to steer, as in orders Nos. 5 and 6, Table III. For example, suppose in No. 5 the ship is steering N. 80° E., and it is desired to steer more to port, say 5 degrees, the order is "Steer N. 75° E.," the helmsman gives the necessary amount of starboard helm to get on to the new course.

Similarly, if in No. 6, Table III., the ship is steering S. 45° W. and it is desired to steer more to starboard, say 10 degrees, the order is "Steer S. 55° W.," and the helmsman gives the necessary amount of port helm to get on to the new course.

When making any alteration in the course, sufficient helm should be given to make the ship's head move at once. If the alteration is small, the helm should be eased as soon as the ship's head begins to move, and this may be observed by watching the land or the horizon; the ship's head will be seen to move before it is indicated by the compass.

NOTES.—A helmsman, on taking over the wheel, should always ascertain the amount of helm the ship is carrying,

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as it frequently happens that owing to wind or sea the ship will be carrying a few degrees of port or starboard helm in order to keep her steady on the course. In a calm the helm can generally be carried amidships.

When steering a course endeavour should be made to move the helm as seldom as possible, and then only by a small amount. A good helmsman will keep a steady course with only one or two degrees of helm under favourable conditions, whereas a bad one keeps his helm continually on the move, using large amounts which result in an irregular course and very great inconvenience to ships following in the wake.

If the rudder is put over to large angles it retards the speed of the ship through the water.

When steering by means of a small wheel operating an engine it should be moved steadily throughout the turn, and should not be started or brought up suddenly. A jerky movement should be avoided, as irregular movements are very bad for any type of engine.

(II.)—Sailing Vessels and Boats.

(II) May be divided into two classes of orders (*c*) and (*d*)—

(*c*) Giving directions how the helm is to be placed.

(*d*) Giving directions as to the course to be steered.

Although there are no sailing vessels in the Navy, there are plenty of sailing boats, and in the Mercantile Marine there are still sailing vessels, so that it is necessary to understand the orders for steering vessels under sail. These orders apply equally to the smallest sailing boat and the largest sailing vessel.

Under sail the direction of the wind relatively to the vessel or boat has to be considered; the side upon which the wind is blowing is called the "weather side," the opposite side being called the "lee side."

The terms used when steering steam vessels and pulling boats, viz., "Port" when the helm is to be put to port, and "Starboard" when the helm is to be put to starboard, are not made use of when under sail, except when the wind happens to be right aft, and there is no weather and lee side. The terms "weather helm" and "lee helm" are used to indicate that the helm is to be moved to the weather (*i.e.*, the windward side of the vessel) or to the lee (or leeward) side. Greater vigilance and care is required to successfully steer a vessel under sail than under steam. The course of the former is dependent on the direction of the wind and the helmsman must therefore keep a constant eye on the sails to watch the effect on the wind, more

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especially when sailing "close hauled." He should therefore be on the weather side of the steering apparatus.

Sailing vessels are necessarily limited as to the directions in which they can proceed owing to the limitations imposed on them by the wind. The nearest point they can approach the direction of the wind is when they are close hauled; in square rigged vessels this is about 6 to 6½ points. Fore and aft rigged vessels can, of course, lay closer, this depends upon the design of the hull and the sail plan.

Terms and Orders given.	Procedure and how carried out.
Bear up – – – / Keep her away – –	To keep further away from the wind by putting the helm "up" or to "windward."
No higher – – –	Not to come any closer to the wind. Weather helm to be used. This term is used when steering "close hauled," "full and bye," and "by the wind."
Steer more to leeward – / Steer the course indicated by compass (to leeward).	To keep further away from the wind by putting the helm to "windward."

In the foregoing:—
The tiller is put to "windward."
The "lee" yoke line is pulled.
The wheel is turned to "leeward."
The rudder will go to "leeward."
The vessel's head will go to "leeward."

Terms and Orders given.	Procedure and how carried out.
Luff – – – –	To keep closer to the wind by putting the helm "down" or to "leeward."
Haul to the wind – –	To bring the vessel's head close up to the wind by putting the helm to leeward.
Nothing off – – –	Not to keep more off the wind. Lee helm to be used. This term is used when steering "close hauled," "full and bye," or "by the wind."
Steer more to windward – / Steer the course indicated by compass (to windward)	To keep nearer to the wind by putting the helm to "leeward."

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In the foregoing :—

The tiller is put to "leeward."
The "weather" yoke line is pulled.
The wheel is turned to "windward."
The rudder is turned to "windward."
The vessel's head will go to "windward."

As in the case of steam vessels, all orders must be repeated by the helmsman.

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CHAPTER VI.

BOAT WORK.

The build of a boat is generally determined by the method of working the planking or skin of the boat.

There are three methods, viz. :—Clinker (or Clencher), Carvel, and Diagonal.

Clinker-built Boats.—In these boats the planks run fore and aft with the lower edge of one plank lapping over the upper edge of the next below, like the slates on the roof of a house. The smaller pulling boats in the Service are clinker built.

Carvel-built Boats.—In these boats the planks run fore and aft but do not overlap, the edges being fitted close together (like the staves of a cask), so as to give the bottom a flush and smooth surface.

Diagonal-built Boats.—In these boats the planks are worked with their edges fitting close to one another as in carvel-built boats, but standing at an angle of about 45 degrees with the keel line. Sailing launches and pinnaces are diagonally built in two thicknesses, the inner thickness having the gunwale ends of the planks falling aft and the outer thickness the gunwale ends falling forward.

Steamboats are built with two thicknesses of planking, the inside being worked "diagonally," and the outside "carvel."

Montagu Boats.—During the last few years various modifications have been made in the shape and construction of the pulling boats supplied to H.M. ships. Many of these have been suggested by Admiral Montagu. In the 27-feet whalers the greatest number of modifications have been introduced, and the principal of these are as follows :—

Originally this boat had a straight keel, with a straight and nearly vertical sternpost. In the new pattern boat the keel is slightly cambered and the sternpost is considerably curved, the after deadwood being almost completely cut away. The forefoot has also been cut away to a slightly greater extent than in the older boats. The extreme breadth has been increased about six inches, and the after lines of the boat filled out, the breadth at backboard measured at the gunwale being about 18 inches greater than formerly. The depth of the boat has also been increased, a dropkeel has been added, and this, with the

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increased breadth and fulness aft enables the boat to carry a greater area of sail, viz., 189 square feet, against about 168 square feet in the older type. Two masts are fitted, a main and a mizen, as compared with a foremast and mainmast, and these are situated much further aft than in the older boats. The mainmast carries a foresail and a dipping lug and is about five feet longer than the foremast in the older boats. It ships into a mast clamp secured against the after edge of the second thwart. In the older type the mainmast shipped into a hole in a fore and aft gangboard, fitted between the first and second thwarts. The mizenmast is about the same length as the mainmast in the older type and ships through a cross-piece fitted just abaft the backboard. It carries a small leg-of-mutton sail overhanging the sternpost and provided with a boom. A trysail is also supplied which can be rigged in place of the dipping lug or rigged as a spinnaker.

The rudder is increased in breadth and area, and projects below the keel line instead of being above the keel line as originally. Its shape is also different to allow for its fore edge fitting snugly around the curved sternpost.

The construction of the boat is stronger than in the older type, heavier scantlings being generally employed. The stern benches are formed of open-spaced battens, whereas in the older boats solid benches with gratings in panels were fitted. The portable washstrakes in the older boats are not fitted in the newer type.

The above are the chief points of difference in the 27-feet whalers. There are other small points of difference which are, however, of little importance. The scantlings being heavier, and the boat slightly broader and deeper, it follows that the weight of the boat is increased. This increase is about 1 cwt.

The chief differences between the new and old patterns of gigs, galleys, and cutters are that the keels are cambered instead of straight, the forefoot has been cut away more, and the stern benches are formed of battens as in the 27-feet whalers instead of being solid with gratings on top.

See sketch of Montagu whaler backing figure facing page 247.

Materials.—The skins of the smaller boats are generally of elm, and those of the larger boats, both pulling and steam, are of teak; the portions of the boat grown to form, viz., stem and knees, are of oak, the remainder of the structure and also the fittings are generally of elm or fir.

In torpedo boat destroyers special light boats, generally of fir, are used, and Berthon collapsible boats are also carried. These collapsible boats had formerly a skin of reindeer hair, but now the skin is of canvas, with a framework of Canadian elm.

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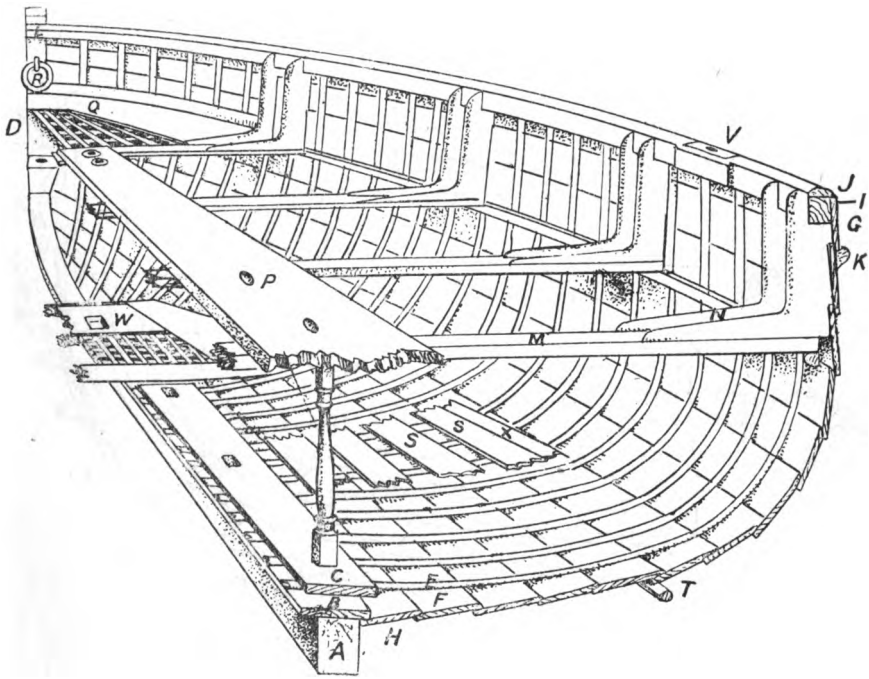
[*To face page* 202.

CLINKER BUILT BOAT.



A Keel.
B Hog.
C Keelson.
D Stem with Apron Pin.
E Timber or Floors.
F Planks.
G Top Strake.
H Garboard Strake.
I Gunwale.
J Capping.
K Rubber.
L Breast Hook.
M Thwart.
N Knees.
O Risings.
P Sailing Thwart.
Q Head Sheets.
R Ring Bolt.
S Bottom Boards.
T Bilge Piece with Handholes.
V Rowlock or Socket for Crutch.
W Fore Sheets.
X Stretcher Rail.

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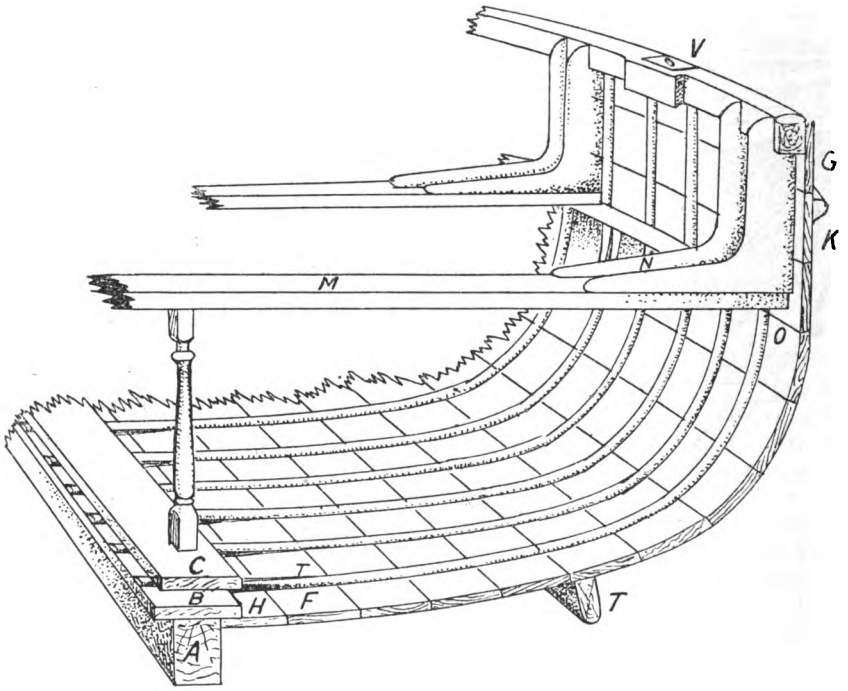
CARVEL BUILT BOAT.



A Keel.
B Hog.
C Keelson.
E Timber or Floors.
F Planks.
G Top Strake.
H Garboard Strake.
I Gunwale.
J Capping.
K Rubber.
M Thwart.
N Knees.
O Risings.
T Bilge Piece with Handholes.
V Rowlock or Socket for Crutch.

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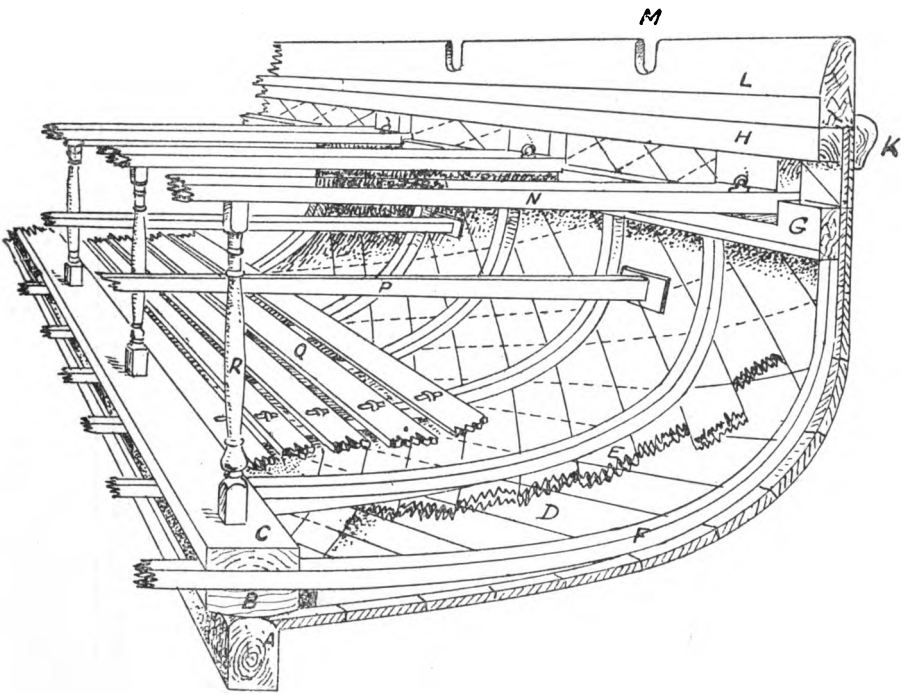
DIAGONAL BUILT BOAT.



A Keel.
B Hog.
C Keelson.
D Plank (Outer Skin).
E Plank (Inner Skin).
F Floor.
G Shelf.
H Gunwale.

K Rubber.
L Washstrake.
M Rowlocks.
N Thwarts.
P Stretcher.
Q Bottom Boards.
R Pillar.

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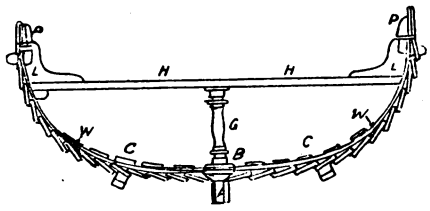
Parts of a Boat.

30 ft. CUTTER.

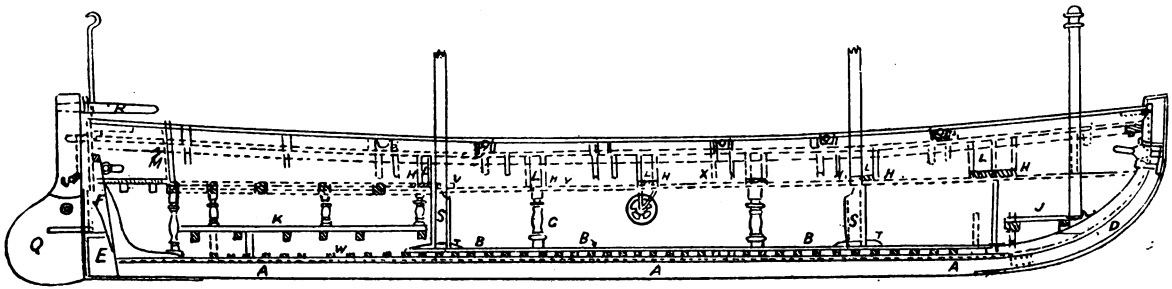
Section.

A Keel.
B Keelson.
C Bottom Boards.
D Stem.
E Stern Post.
F Transom.
G Stanchion.
H Thwarts.
J Head Sheets.
K Stern Sheets.
L Knees.



M Backboard.
O Rowlocks.
P Poppets.
Q Rudder.
R Tiller.
S Tabernacle.
T Mast Step.
V Mast Clamp.
W Floors.
X Rising.
Y Rudder.

Profile.



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Parts of a Boat.

Backboard.—A piece of wood, usually ornamented, shipped across the after end of the stern benches.

Barricoes.—The small casks which are stowed between the thwarts on the bottom boards, and contain provisions, drinking water, or water ballast.

Boomkin.—A portable boom fitted at the stern and overhanging it. At its outer end is a block through which the mizen sheet is led.

Boomkin Clamp.—A metal clamp on the transom for keeping the boomkin down in its place.

Bottom boards.—Are pieces of wood fastened together, laid over the bottom of the boat as a flooring, for gear to rest on, &c.

Bow.—The foremost end of the boat.

Cleats.—Pieces of wood or metal secured to the sides of a boat for belaying sheets and halliards to.

Counter.—The overhanging portion of the stern.

Crutches.—The substitute for rowlocks in single-banked boats. They are made of metal, more or less fork-shaped, and shipped in the gunwale for the oars to work in, and are fitted with lanyards.

Floors.—Are the transverse frames or ribs which run across the boat from gunwale to gunwale, fitting against and fastened to the planking, and assisting the latter to retain the form.

Grapnel.—The boat's cable, made of chain or rope.

Gripes.—Two pieces of sword matting, the upper ends being secured to the davit heads and the lower ends being secured to a monkey tail slip on the opposite davit; they cross diagonally on the outside of the boat and keep it hard against the griping spar.

Gudgeons.—Eyes which ship over the pintles. The lower is on the rudder and the upper on the stern post.

Gunwale.—A square piece of wood running round the inside of the boat at the top. The upper edge of the boat.

Head Sheets.—The small platform at the foremost end of the boat.

Keel.—The lowest part of the boat; it forms a backbone into which the boat is built.

Keelson Board.—A piece of wood at the middle line of the boat, running along on the top of the floors; it extends for about two-thirds the length of the boat, to which the mast steps are secured, and into which the thwart pillars are stepped.

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Knees.—Pieces of wood grown to the shape required, and used for securing the thwarts to the sides of the boat.

Lazy Painter.—Similar fitting to a painter, but of smaller rope; used for hauling a boat up to the Jacob's ladder. It should not be used for securing the boat.

Mast Step.—A piece of wood secured to the keelson, into which the heel of the mast steps.

Mast Clamp.—A metal clamp for securing the mast to the thwart.

Painter.—A piece of rope spliced into a ring, secured to the apron and stem of a boat; used for towing or making the boat fast.

Pintles.—Vertical pins on which the rudder ships and turns. The lower one is on the stern post and the upper one on the rudder.

Poppets.—Are pieces of wood which fit into the rowlock spaces. They are shipped whenever the oars are not being used, except when the boat is hoisted as a lifeboat. They are fitted with lanyards.

Rowlocks.—Spaces cut in the boat's gunwale to work the oars in.

Rudder.—Either of wood or metal, hung on the stern post, by means of which the boat is steered. Is fitted with a lanyard, which is secured to the boat.

Running Hook.—A hook fitted in bow of boat, from which tack of foresail is shifted for running.

Steadying Lines.—Are of hemp and chain, and go from the ring in the centre of the slings to the gunwale, the chain on each sling being on opposite sides of the boat. Their use is to keep the boat upright when being hoisted.

Slings.—Two spans of chain, one forward and one aft. The foremost sling has one end secured to a ring bolt in the stem and the other end to a link plate fastened to the keel. The after one has one end connected to a ring bolt in the stern post and the other to a link plate fastened to the keel.

Stem.—Is the foremost continuation of the keel, scarped or tenoned into the same, and to which the planking at the fore end of the boat is fastened.

Stern.—The after end of the boat.

Stern Post.—Is the after continuation of the keel, scarped or tenoned into same, and on which is hung the rudder by means of pintles and gudgeons.

Stern Sheets.—Is the platform extending from the after thwart aft.

Stretchers.—Pieces of wood laid athwart the bottom boards, and fitting into chocks on them, against which the rowers place their feet.

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Tabernacle.—A wooden frame extending from the mast thwart to the mast step, for guiding the heel of the mast into position.

Tack Hook.—A metal hook on the stem for hooking the tack of the foresail to.

Thwarts.—Seats placed across the boat for rowers to sit on.

Tiller.—A long piece of wood or metal fitting into the rudder head for working it.

Transom.—A board fitted to the after side of stern post, to which the after ends of side planking are fastened.

Yoke.—A crosshead of wood or metal shipping on the rudder head, to which yoke lines are attached for working the rudder.

Stowage of Boats.

Steamboats, launches and pinnaces are stowed inboard in crutches and are termed "boom boats"; they are hoisted in and out by the boat derrick either by hand or power. In some cases the pinnace stows in the launch, in which case the launch's thwarts are unshipped and resting chocks placed for the pinnace to rest in. These boats are secured for sea with chains which set up with a bottle screw to bolts in the deck.

All other boats are carried at davits, and can either be turned inboard on their davits and left on the davits or lowered into crutches, or hoisted inboard and stowed on the boat deck. The lower blocks of the davit falls are all fitted with a strop and thimble which hooks over the hook in the slings of the boat, and when the boat is lowered in harbour it is secured to a ring bolt in ship's side or to the boat's davit with a strop and toggle. The upper inner block of the fall is a swivel block and the outer one a fixed block; between the two upper blocks is a chain slip and screw for taking the weight of the boat when turning her in or out.

To Turn a Boat in.—If the griping spar is in position it must be unshipped and placed in the boat. The boat hung by the davit chains, a line passed from aft into the stern of the boat outside the after davit, or bent on to after davit guy, slip both guys and haul aft; as soon as the foremost davit is fore and aft haul in on foremost life-line and ease the after line.

If turning a boat in at sea, the gripes must first be slipped, but should the ship be rolling, pass the ends of two grass hawsers or large hook ropes over the boat, secure the ends and snatch and man the other parts before slipping the gripes so as to prevent the boat from swinging about.

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To Lower Davit ("Dreadnought" Class).—Take off gripes, relieve standing lifts A by taking weight on purchase B, disconnect standing lift and connect again to link 1 for harbour, or 2 for sea positions, lower away on purchase B with the aid of overhauling purchase C, the weight of the boat is taken on hook rope D, and davits fall outboard. When in sea position jackstay E and griping bands should be rigged.

To Lower Boat.—Disconnect hook rope D, slip gripes, and lower away on purchase B.

To Hoist Boat and Top Davit.—Connect pendants F to disengaging gear in boat, haul away on purchase B until the boat is high enough for disc H to foul the upper block, continue hauling on the purchase which will top the davit to the required position.

To Secure.—Connect hook rope D to boat's slings, rig and pass griping bands and standing lifts A.

Gear contained in a Service Pulling Boat.

Requisite number of oars according to size of boat with two spare in double-banked boats and one spare in single-banked boats, to be laid in the boat with the blades forward.
Boat-hooks.
Masts and sails. Sails to be in their painted covers.
Awnings and awning stanchions (in hot weather).
Anchor and grapnel.
Two painters.
Rudder and lanyard.
Two tillers (one short for pulling, one long for sailing).
One yoke for pulling and one tiller for sailing in single-banked boats.
Boat-slings.
Backboard.
Stretchers.
Fenders.
Poppets with lanyards in double-banked boats.
Crutches with lanyards in single-banked boats.
Ensign and pendant, with respective staffs and trucks.
Signal book in cover, and answering pendant.
Water barricoes and baler.
Boat's bag, containing spun yarn, tallow, palm and needle, marline-spike, twine, wax, hammer, chisel, tommy and punch.

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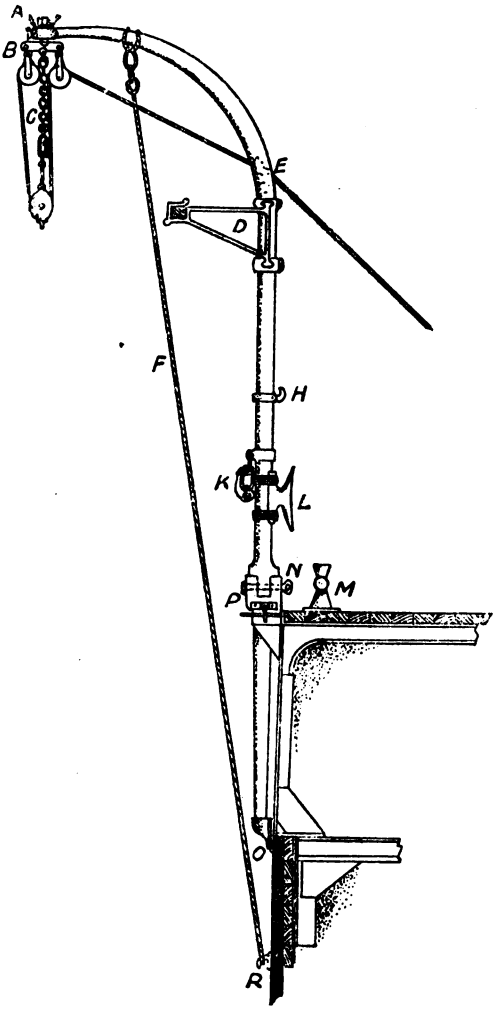
[*To face page* 206.

BOAT'S DAVIT.



A Eye plate for davit guy and spreader jackstay.
B Cross head with blocks for boat falls.
C Suspending chain and slip.
D Fitting for griping spar.
E Metal fairlead for falls.
F Lifeboat jackstay.
H Hook for awning.
K Slip for gripes.
L Cleat for falls.
M Boat lowering bollard for lifeboats.
N Bolt securing hinge joint.
O Heel socket.
P Pin to prevent davit turning.
R Hook plate.

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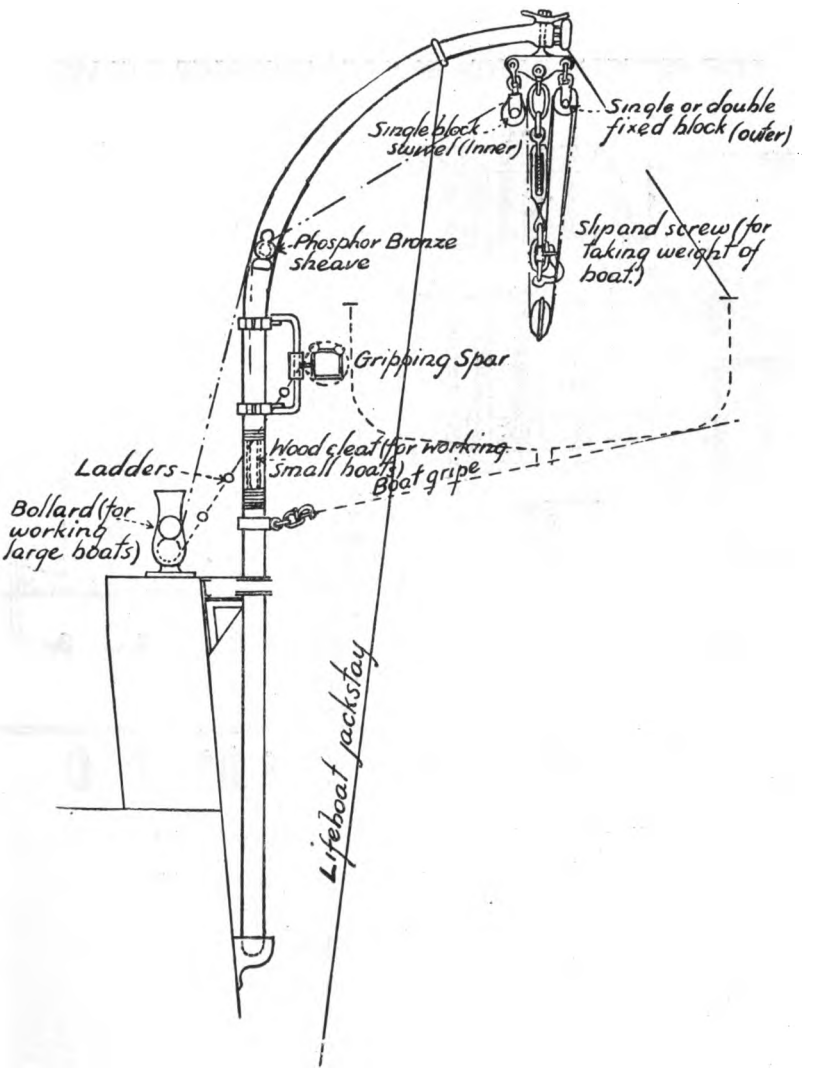
BOAT'S DAVIT.



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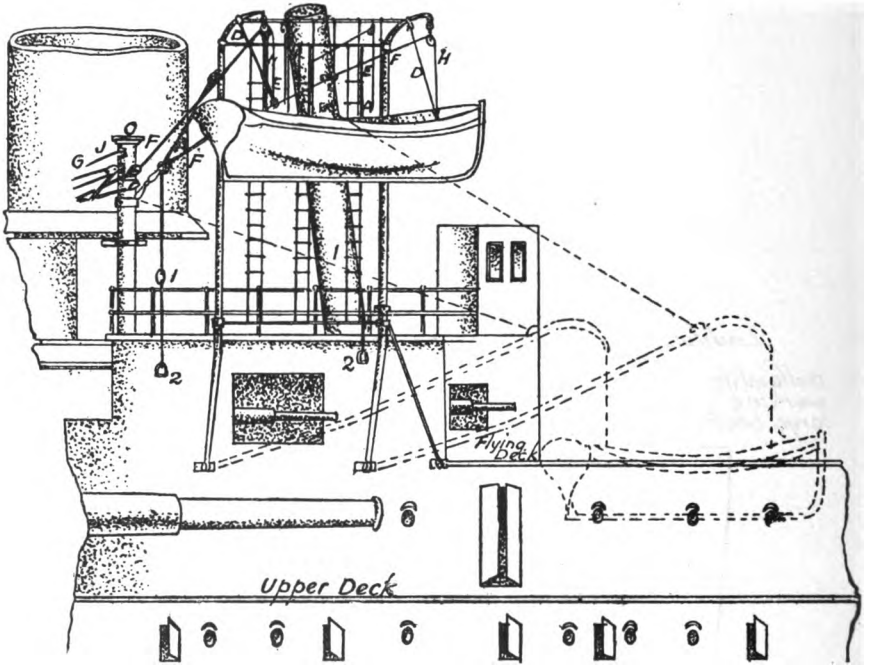
LIFE CUTTER'S DAVITS IN "DREADNOUGHT" CLASS.



A Standing lifts to davits with slip and screw and spring box.
DD Hook ropes.
E Steel wire jackstay secured to eye plate on ship's side.
F Steel wire pendants to davits.
H Steel disc.
J Steel wire jackstay as guide for tackles.
O Stump mast.

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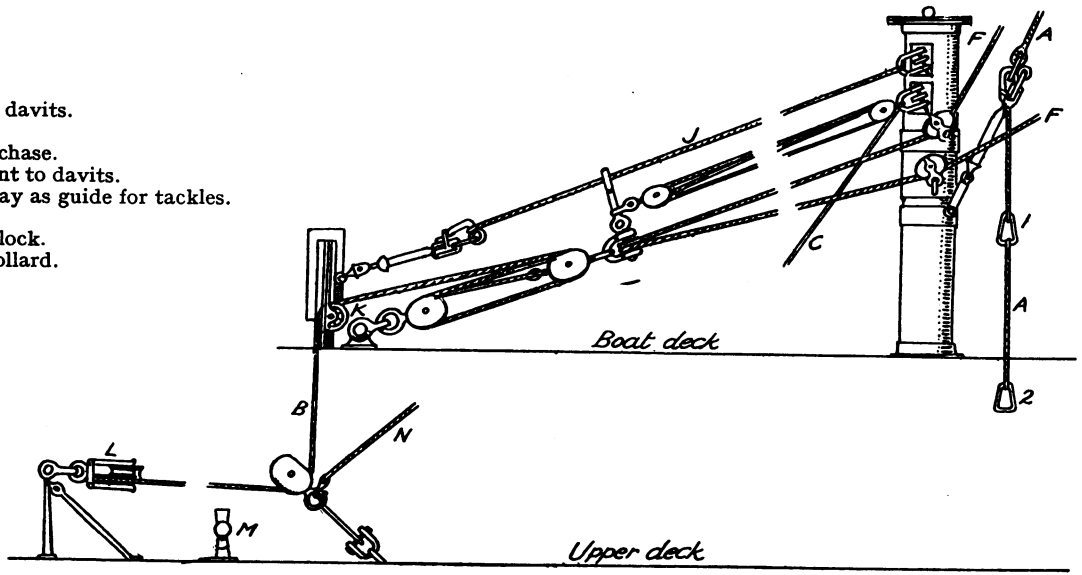
METHOD OF WORKING DAVITS.

A Standing lifts to davits.
B Treble purchase.
C Overhauling purchase.
F Steel wire pendant to davits.
J Steel wire jackstay as guide for tackles.
K Fairlead sheave.
L Double snatch block.
M Boat lowering bollard.
N Hook stopper.
O Stump mast.



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BOAT PULLING.

Method of Instruction.—The boat's crew having taken their places in the boat on the thwarts assigned to them, will see their oars clear, and each boy, seizing his own oar by the loom or handle, will lift the blade on the gunwale of the boat, keeping it as far forward as possible, ready for tossing up.

Up Oars.—The coxswain, when everything is ready, will give the order "Oars up," when, taking time by the stroke oarsman, the crew will toss their oars up into a perpendicular position, placing the looms on the bottom boards between their feet. The oars must be kept upright and the blades "feathered" fore and aft and in line with the stroke oars.

NOTE.—The coxswain should then give his attention to the following details :—

(*a*) Fit of the stretcher.
(*b*) Position of the boy on the thwart.
(*c*) Length of the oar.

With regard to the position of the boy, the coxswain must see that he sits square, as if he were unconscious on which side he is going to pull, about two-thirds on the thwarts.

His shoulders set well back and stiffened. Any attempt to stretch them as he reaches out, and so add to his reach, loses more than it gains.

Heels together on the stretcher, toes turned out to an angle of 45°.

The boy should always look aft, and never watch the blade of his oar.

Shove Off.—At this order from the coxswain, the bowmen who have been, with the inside stroke oarsman, holding on to the side of the ship, shove the boat off with their boat-hooks. The stern oarsman does the same with the stern boat-hook. They then place their boat-hooks in the boat amidships with the heads forward and aft. The stroke oarsman tosses his oar up independently, the bowmen run their oar blades out over the bows together, toss their oars, touch the blades, then wait further orders. If the rest of the crew, as is usually the case, have commenced pulling, they would "down" together and pick up the stroke.

Where fenders are fitted, they are hauled in, either at the order "Shove off," or at a separate order of "Fenders in," and they are put over in a similar way on coming alongside.

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Down.—As soon as the boat is clear, the coxswain gives the order "Down," at which the crew lift their oars till the looms are clear of their knees and lower the blades quietly into the water, then allow the oars to fall into the rowlocks. This, when the oar blades are feathered and in line with the gunwale, is called the position of "Oars."

Pulling by Numbers.—The crew will be taught to pull by numbers as follows:—From the position of "Oars," at the order "Stand by," the body is bent forward at the hips and between the thighs, back straight, shoulders braced back, and the arms extended to the full extent. The blade of the oar should be at right angles to the water and about one foot clear of it. The knees to be well apart.

The hands should grasp the oar, the inner hand holding it at the end of the loom with the first two joints of the fingers, the other hand about 3 to 6 inches from it, with the right wrist slightly arched, both thumbs underneath. The head must be kept erect, the eyes on the back of the man in front. The chest and belly full and prominent.

One.—Drop the blades of the oars into the water without chop or splash. As the oar enters the water (taking care that the surface of the blade remains perpendicular), put the weight of the body on the oar, arms and back remaining straight, drive with the legs against the stretcher until they are straightened and the body is about 22½ degrees past the perpendicular.

The body must then remain stationary, while the arms bring the oar home by bending the elbows and keeping them close to the body until the root of the thumb touches the breast about one inch below the nipple.

NOTE.—The knees during this movement should close slightly. This movement is an excellent exercise for strengthening the back, stomach, thigh, and loin muscles, which play such an important part in rowing. When the boy is well stretched out he should try and begin the stroke by feeling the water, and it then should develop into a hard steady pull.

Two.—Drop the arms until the blade is clear of the water.

Three.—Turn the wrists and feather the oar.

Four.—Shoot the arms out sharply, but without a jerk, and swing the body slowly and steadily forward to the position of "Stand by."

NOTE.—After the motions have been distinctly taught, combine the first, second, and third at the order "Stroke,"

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completing the fourth motion at the word "Recover." Great care should be taken that the body comes steadily aft, otherwise the boys drop their shoulders and head, and then the blades, instead of being as close to the water as possible, are uneven and cannot enter the water at the same time.

When the crews have been thoroughly practised in the combination, pulling in quick time should be carried out, the order being "Give way."

This will require to be gradually taught, and the crew only allowed to pull at first a few strokes at a time till the necessary muscles become sufficiently accustomed to the exercise.

They should always remember that the main object is to pull correctly, and that pulling hard and for a long distance is merely a matter of practice, but that a bad style once contracted is like a bad habit, hard to get out of.

It must be impressed upon the boat's crew that their oars are to be pulled more by their legs than by their arms, and that both hands, both arms, both shoulders, each loin and both legs and feet should bear an equal strain throughout the stroke.

The stroke should be finished with the shoulders and the muscles that work them, and the biceps should be passive throughout the stroke.

The whole secret of pulling lies in the body swing and good leg work against the stretcher.

Laying on Oars.—At the order "Oars," the crew will come to the position of "Oars" as previously described, taking time by the stroke oars.

Tossing Oars.—The caution "Stand by" to toss your oars will be given. At the order "Up," given at the conclusion of the stroke, the crew will give the looms a sharp cant downwards and raise the oar into a perpendicular position, placing the looms on the bottom boards between the feet, blades feathered and in line.

Boating Oars.—At the order "Boat your oars," the oars will be lowered quietly into the boat, and the looms run aft and squared at the after thwart by the stroke oarsmen.

Coming Alongside.—When the boat gets within 50 yards of the ship or landing-place the order "Bows" will be given, at which order the bowmen will toss their oars in together, touch the blades and boat their oars quietly; they will then stand up in the bows with their boat-hooks ready to get hold or fend off. Fenders are put out at the same time or by a separate order. The order "Way enough" will be given when the boat has enough way on

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her to reach the gangway, and at this order the crew, taking time by stroke oarsmen, will toss their oars as described in "Tossing oars." The stroke oar nearest the ship or landing-place boats his oar and stands up in stern sheets with stern boat-hook. The orders "Oars," "Bow," "Way enough" are all executed one stroke after the order has been given.

These orders should be given in the middle of a stroke, *i.e.*, when the oars are in the water, thereby avoiding confusion.

In single-banked boats coming alongside, only the bow oar is tossed in. The remainder at "Way enough" let their oars go fore and aft, those on the side nearest ship being lifted out of the crutches and boated, blades aft, to save the blades from damage.

Notes on "Style" and Faults to look out for.

(*a*) **Swing.**—The aim in this should be to swing the body as far as possible from the hips without bending the back, being careful to let the head swing with the body. The swing must be slow and balanced, for the time occupied in coming forward should be the body's rest, when the easy-measured swing, erect head, braced shoulders and open chest enable heart and lungs to work freely and easily, in preparation for a definite beginning of the next stroke.

As the body swings, the hands should be at the same time stretching and reaching out as if constantly striving to touch something which is as constantly evading them.

(*b*) **Straight Back.**—Subject to individual differences of build, a straight back should be acquired. The values of a straight back are :—

1. That the man who so rows must be swinging from his loins only at the hips, and not from any point in the middle of his back as a secondary pivot.
2. That the straightness of the back, to some extent, eases the respiratory organs.

(*c*) **Use of Arms.**—The arms must be straight when swinging back. They must be considered as merely connecting rods between the body and the oar. The use of the biceps in rowing should be discouraged, as the man who finishes his stroke by the aid of the biceps infallibly dog-ears his elbows and sticks them out at right-angles to his ribs, giving a weak as well as a cramped and ugly finish. The stroke should be finished with the shoulders and the muscles that work them, and the biceps should be passive throughout the stroke. The best way to make a

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man use his shoulders instead of his biceps is to accustom him to feel a strain upon the former. To do this, make an offender in this respect row a stroke solely with the body swinging and legs driving against the stretcher, and in practising this the arms need not be bent at all at first, but kept out rigid, as if they were merely connecting body to the oar.

"*Polish your ribs*" is a useful phrase to indicate position of elbows towards finish of stroke and to prevent elbows sticking out from body. The elbows should begin to bend just before the body attains its limit of backswing. Hands should then sweep into the chest on an even plane.

(*d*) Do not meet your oar, *i.e.*, keep your body back until the hands have come in. If you pull yourself forward to meet your oar, you will certainly shorten the stroke prematurely.

(*e*) **Turning of Hands towards end of Stroke.**—Hands must be dropped before wrists are turned, to get blade clear of water first, and to ensure neat and clean feather.

(*f*) **Hanging at Chest.**—Do not allow oar to hang at chest. Hands should come away quickly, otherwise it will be necessary to rush forward in the swing to make up lost ground. This spoils the swing and taxes the endurance of the man by the extra exertion of the "*bucket*" forward.

(*g*) **Test of a Clean "Feather":—**

1. If the oar is feathered perfectly, it comes out like a knife, leaving a small swirl where it has made its exit.
2. If a sort of feathery sheet of water runs off the blade as it leaves the water, it is "*feathered*" under water, the hands have turned while oar is still in the water.
3. If the oar throws a slip of water aft as it leaves the water, the stroke is finished in the air, and a gradual drop of the hands has taken place before the hands reach the chest. The hands have not preserved their place.

(*h*) **Use of Legs.**—When a beginner has been taught the use of his body, and has begun to utilise the "*swing*" of it for the main motive power of the stroke, he can then be taught to apply extra power with his feet at the right time to increase the power and swing of the body.

As soon as the body feels the strain of the oar, the legs instinctively stiffen themselves against the stretcher. They should be kept in this rigid posture, supporting the body, throughout the stroke. The rigidity should commence at the

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instant the oar touches the water and the strain begins to fall upon the shoulders. It should be a passive resistance, co-extensive with the strain upon the body, commencing and ending simultaneously with it.

(*i*) **Recovery.**—This is largely dependent on the abdominal muscles, and to get quick recovery these muscles must be exercised and developed. A man must also learn to economise them and to use such strength as they possess to the best advantage. The muscles of the legs, thighs, and loins should all join with those of the abdomen in the recovery, though necessarily the greater strain falls upon the last-named. The first part of the recovery should be the most rapid.

(*j*) **Catch.**—The beginning of the stroke should be the most forcible part. This "*catch*" should be driven from the body as if the whole body were to be lifted off the seat by the joint support of oar and stretcher. Avoid striking the water in the "*catch.*"

(*k*) **Form.**—May be defined and made up of square shoulders, straight swing from the loins, elastic recovery, absence of doubling up at the finish; also absence of "*hang*" and of "*bucket.*"

(*l*) **Distance of Swing Back.**—In deciding this, two things must be considered, viz. :—

1. Whether the man is physically capable of maintaining his length of "*swing back*" without sacrificing some of his "*reach forward.*"
2. Whether his powers of recovery are adequate to the distance through which his body has to be recovered for the next stroke.

If both these can be done, then the man who fulfils these conditions is doing his work to best advantage; if his body, when straight at the end of stroke, makes an angle of about 22½ degrees (one-fourth of a right angle) with the perpendicular, the reach forward will have been full.

It is more economical to recovery to swing fairly well back and to row a fewer number of long strokes in one posture, than a large number of short strokes.

In teaching a man to swing back, he should be told to hold his head well up. The weight, if thrown back, assists his swing, while if hanging forward, it acts in a contrary direction.

(*m*) **Faults to look out for :—**

1. Finishing strokes with biceps instead of with muscles behind the shoulders. Result :—Elbows stuck out or dog's-eared.

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2. Faulty grasp of the oar is at the root of scores of faults.
3. Over-reaching with shoulders, instead of with the shoulders braced as they should be.
4. Meeting the oar, and rowing deep at the finish. Usually both arise from rowing finish of stroke with arms only.
5. Screwing to one side or other, due to oarsman endeavouring to do the work with one arm or one leg in preference to the other.
6. Feathering under water. Due to faulty hold, or to slurring the two motions of "*drop*" and "*turn*" of the hands into one motion.
7. Uneven swing forward. Due to sluggish or early recovery, or to the misuse of the muscles which ought to be used in recovery.
8. Faulty time. If a good swing is obtained, the time will probably become right.
9. Not rowing stroke home. Due to weakness or from cramped attitude of finish, or an over-reach of shoulders when forward, or to the oar being taken out of the water too soon.
10. Swinging across the boat. Usually due to not sitting square, or to leaning too much on the oar in going forward.
11. Fouling the water in going forward. Due to either too short a stretcher, or that hands do not drop sufficiently at finish of stroke, or that hands are not shot out quickly enough from chest.
12. Bending the arms too soon. Often due to lack of full use of muscles of back, loins, and legs, and to a desire to supplement them by use of arm muscles in the first catch of the water.
13. Want of catch is a want of knack of using power at right time.

Clipping the water must be avoided.

The stroke, when once caught, must be held, drawing it well through.

Hints to Instructors.

(*From "Rowing and Sculling," by W. B. Woodgate.*)

1. Keep your temper.
2. Be lucid in your explanations.
3. Demonstrate faults and excellence practically.

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4. Trace faults to their origin, distinguishing between cause and effect.

5. Avoid generalities in coaching, better to (in turn) pick out and address individuals in correcting faults.

6. Note how each pupil progresses periodically, and inform him.

7. Look out for defects in gear which might be the cause of one of the crew pulling badly.

8. In teaching a boat's crew, split the instruction up into distinct pieces of practice, dividing the stroke up and practising each part and then doing all parts together.

9. Insist on eyes being kept in the boat.

10. It is a good plan to teach men to let the ear guide the finish of the stroke and the eye the beginning. A definite and simultaneous rattle as the oars all feather sharply together marks the finish distinctly and enables the men to bring the stroke to a close simultaneously. When this is done the boat is steadier, and the oars, having all finished together, start fair for simultaneous recovery, and so for a simultaneous "*catch*" of the water at the next stroke.

Notes on Exercise for the Training of Boats' Crews.

(*Quotations from Isthmian Library on Rowing.*)

1. Avoid all exercises that tend to make men muscle-bound, such as heavy weight lifting.

2. Cultivate any exercises that are similar in movements to those assumed in rowing especially those entailing the free swing of the body from the loins and the working up of the abdominal muscles, also the heaving movements used in the physical training handbook.

3. Cultivate the leg muscles by running, jumping, and vaulting, as laid down in the physical training handbooks.

4. The daily sequence of exercises used in naval physical training is eminently adapted to keep the body supple, normally exercise the whole body, and get a good circulation of the blood, insuring health. Get the gymnastic instructor to put crew daily through a table of exercise from the physcial training handbook, gradually increasing the strength of the exercises. The tables suggested for use are those in the training of gymnastic instructors, beginning at Table 5 or 6. These include leg movements, heaving movements, dorsal exercises, abdominal exercises, and others, all of which are recommended.

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5. But it should be borne in mind that in the main rowing must develop for itself the muscles it requires. It is an exercise which, when all is said and done, can only be learnt effectively in a boat on the water. Therefore a daily pull is necessary, increasing length of it gradually.

6. What is required is to aim at getting freedom of joints, supple muscles, limbs and brain acting conjointly, and lungs acting freely.

Lowering Boats.

When a boat is called away to lower, the stroke and bow oarsmen go into the boat, see the plug is in, and everything clear for lowering; then standing *between* the falls, they will lay hold of the life-lines and be lowered by the rest of the crew.

When the boat is in the water, the falls are unhooked (after fall first), the lower blocks toggled to bolts in the ship's side, and the boat either pulled out to the boom or alongside the gangway. The remainder of the crew haul the falls taut and gather up the life-lines and then man their boat.

Hoisting Boats.

When a boat is called away to hook on, the same hands go into her, clear away the slings, drop under the davits and hook on the falls (foremost one first), which should have been rove.

When ready the boat is hoisted, the men in the boat standing *between* the falls and lighting themselves up by the life-lines, taking the plug out as soon as the boat is clear of the water. When high enough they will pass the life-lines under the hook of the slings, over the davit head, and dog the ends round all parts, reporting "all fast forward," "all fast aft"; the falls are then walked back until the life-lines have the weight of the boat, they are then "lighted too" and belayed. As soon as the falls are secured the life-lines are taken off and coiled down clear, oars, masts, &c., neatly squared-off, and the coxswain sees his boat properly square. The crew should then at once wipe off all marks on the outside of the boat.

Disengaging Gear.

It is absolutely necessary when lowering a boat at sea and when the ship has way on her that both the falls should be disengaged from the boat simultaneously, and that the boat should be free from her falls as soon as possible; to effect this, ships are supplied with one of two types of disengaging gear, viz., Robinson's or Pett's. Each ship has three sets, one for each life-cutter and one spare.

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Robinson's Disengaging Gear.

This apparatus belongs to the class in which the release of the boat remains under the control of the person in charge; it therefore makes no claim to be "self-acting."

Robinson's disengaging gear consists of two tumbling hooks so connected as to tumble simultaneously on the release of a line held by the coxswain until he desires to let go, whether before or after the boat becomes waterborne.

By reference to the drawings and description given later, it will be seen that when the line is slacked off about a foot, the hooks become suddenly free to "tumble." Up to that point they can be readily set up again if desired, the arrangement being such that while the releasing line has ample power over the hooks, there is exceedingly little friction; hence a very small strain upon the hooks is sufficient to cant them after the releasing line is slacked, and this makes it almost a matter of indifference whether the hooks are or are not slipped before the boat becomes water-borne.

The hook is pivoted in a frame, which in gigs is steadied and supported by the thwarts, but which in a boat with slings forms part of the span of the slings, and is virtually one of the links in the chain. The steadying lines are fast to the end of the bolt upon which the hook pivots, and as this bolt, which is at the highest point in the slings, is below the gunwale, the position of the hook is little affected by the boat becoming water-borne; the hook remaining suspended by the steadying lines, and ready to cant when called upon. (*See* Fig. 1.)

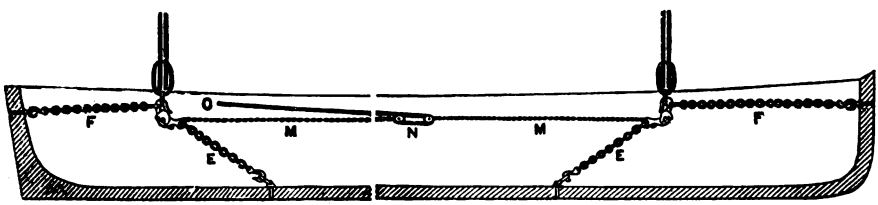

Fig. 1.

It results from this mode of fitting that these hooks are both safe and convenient for hooking on, as they do not require to be held up by hand during the operation, and the man hooking on has both hands free to manage block and ring.

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From the moment of hooking on (unless the releasing chain has been intentionally laid aside, and the safety pins put in, as might be the case in harbour), the apparatus is again ready for use, needing no adjustment after reaching the davits. Hence a man may be stationed to slip the hooks in case of accident in hooking on, thus guarding against a danger little inferior to that of getting away from the ship. It is a further advantage of this plan that the boat hoists very close to the davits.

The releasing line, which lies entirely above the thwarts, is composed mainly of small chain. There is so little rope in it, and so little strain on it, that there is no danger of its stretching sufficiently to risk freeing the hooks by accident. It is therefore unnecessary to keep the safety pins in when the boat is at the davits. One man can take the weight of the boat off the pins when it is necessary to withdraw them.

The arrangement for mousing, as shown in the drawings, is such that whether the safety pins be used or not, the boat can neither be carried away if struck by a sea at the davits, nor become detached if lying alongside.

The mousing plates do not prevent slipping, and, as they can be thrown out of action instantly, they interfere neither with hooking on nor unhooking by hand, if at any time the slipping gear is disused. In fact, the hook may be, and is, used as a common hook without slipping gear, differing only from the common hook by its greater handiness and safety, and by the easy means of mousing it.

In this plan, if the hooks have not been slipped before the boat is fully water-borne, any towing strain will cant them immediately. In the same way any roughness of the water, or even the act of pushing the boat away from the ship's side, will immediately free them.

Hence the services of only one man are required from the time of leaving the davits, and his duties cease entirely when he lets go the releasing line. There is nothing more to be done or guarded against.

Explanation of Sketches of Robinson's Boat-disengaging Gear.

A A is one of a pair of plates which are held together, at about an inch apart, by two rivets B B (Figs. 4 to 6). These plates form in effect one of the links of the chain sling in connection with the shackles C and D and the chains E and F (E leading to the keel, and F to the stem or stern post as the case may be), B B also serve as stops to the hook H and the lever K respectively.

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G is a ring attached to the lower block of the lowering tackle, and it engages with H a tumbling hook pivoted on J, a double-ended gun-metal eye-bolt to the eyes of which the steadying lines are attached at a level lower than the gunwale, so that when there is no strain upon the ring G the apparatus still remains suspended by the steadying lines in the same position as shown in the drawings (*see* Fig. 7). J also serves to connect the frame A A with the shackle D. The tumbling hook H is prevented from revolving by the direct pressure against it of the short end of K, a lever which pivots upon the bolt L, and which in turn is held to its work by the direct pull of M, a light chain which runs fore and aft above the thwarts, and is divided by a single purchase N (*see* Fig. 1), the fall of which, O, is let go by the coxswain when he desires to release the boat, with the effect of allowing the hook to revolve from the position shown in Figs. 2, 3, and 4 to that shown in Fig. 6, when the boat is set free. Fig. 5 shows an intermediate position when the hook is nearly; but not quite, slipped. From this position it can be readily recovered by hauling upon the rope O.

P in Figs. 2 and 3 is a safety-pin, and in Figs. 4, 5, 6 is the hole through which the pin passes. The pin secures the lever K, and therefore the hook when it is desired to dispense with the use of releasing gear. It is prevented from being lost by the small chain Q. It is shown in use in Fig. 7.

R is a sheave for the chain M to travel over. It turns upon S, a bolt which also connects the apparatus with the shackle C.

T is one of a pair of plates which serve to mouse the hook against accidental unhooking (the point of the hook is spoonshaped [*see* Fig. 7], so as to nearly fill the space between them). They are held rigidly together by a rivet V and by a bolt of peculiar make, W, which turns loosely in holes in the frame A A and serves as a pivot upon which the plates can be turned from the position shown in Figs. 2 and 4–7 into that shown in Fig. 3. They are so formed as to remain by their own weight in either of these positions. They therefore do not interfere either with slipping or with hooking on.

NOTE.—The two chains M M (Fig. 1) can be unshackled from their respective hooks and stowed in the bottom of the boat, with the purchase N, if it is desired to use the hooks without slipping gear; or the rope O can be unrove from the blocks and the two parts of the chain stowed separately one under each hook without unshackling.

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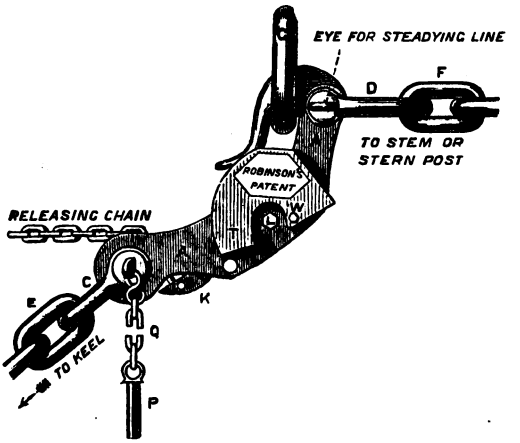
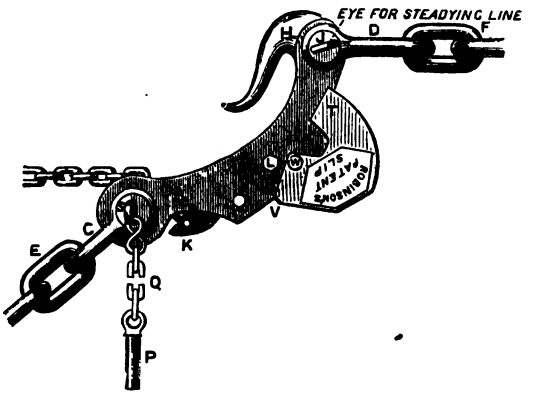
Fig. 2.



Boat suspended ready for slipping; hook moused.

Fig. 3.



Mousing plates thrown back in readiness for hooking on releasing gear, also ready for action in case of accident in hooking on. The apparatus is now suspended by the steadying lines.

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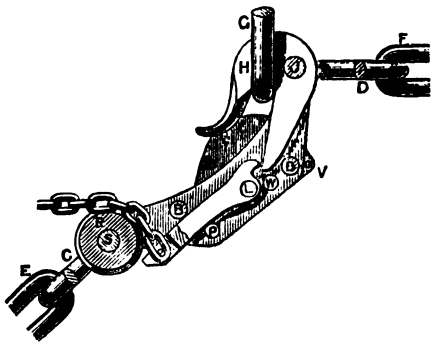
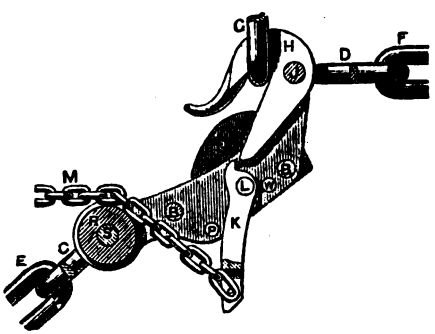
Fig. 4.



Sectional view, boat suspended ready for slipping.

Fig. 5.



Hook nearly, not quite, slipped.

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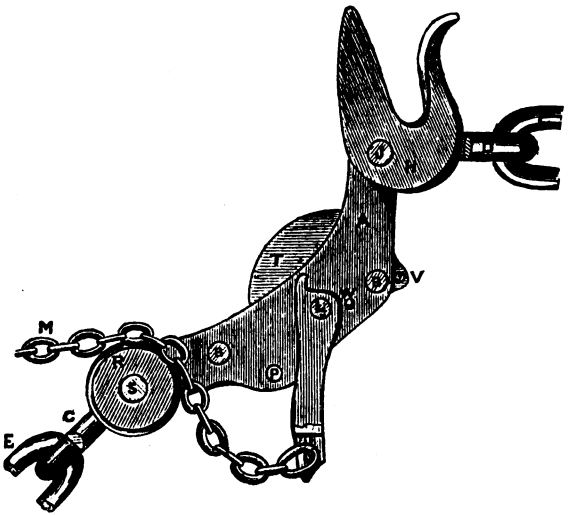
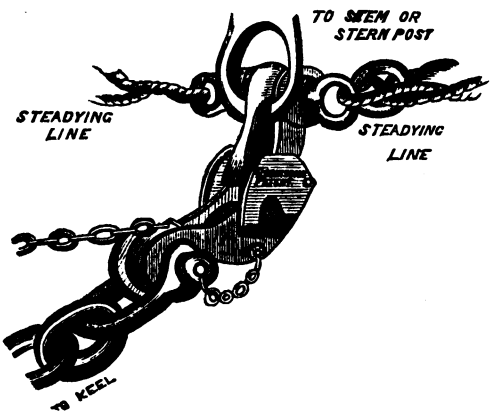
Fig. 6.



Slipped.

Fig. 7.



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Pett's disengaging Gear.

This type of gear, although of later invention than Robinson's, has been used for some years in H.M. Service.

The gear is shown in the accompanying figures and consists of two hooks, M and E, over which fit two rings A, each connected by a link and swivel shackle to the lower blocks of the boat's falls. M is connected at its fore end to the portion of the fore sling secured to the stem, whilst at its after end it can turn about a pin G^1 of a shackle G connected to the keel sling. The after hook E is fitted in a frame F constructed of two side plates of the form shown. There is a middle space between these plates in which E works. The after end of F is connected to the portion of the after sling which leads to the stern post and its forward end is connected by the pin G^1 of the shackle G to the keel portion of the sling. E can turn about G^1. In the figure, E is shown in its held position in which it is kept by a small catch P bearing on its upper edge. By moving the end E^1 of E to the left the upper edge slips from under P, and the end E^1 is free to move upwards between the left side of the frame F and P (*see* section). A forked pin E^2 fits between the sides of the frame F and slips over E. With E^2 in place E cannot be moved to the left and cannot therefore be disengaged from P. A wire fore and after D with a shackle at each end which can be slipped over the rings A keeps, by means of projections C on each side of the rings A—the rings A at an angle of about 30 degrees to the vertical.

To let go the boat when required the forked pin E^2 is taken out of place, the after end E^1 of E is moved to the left to clear P and then let go. The hook E turns about G^1 and releases the after ring A. This relieves the strain on the fore and after D, which causes the fore ring A to slip clear of the hook M and thus frees the boat. It will be seen that if the ship is going ahead the motion helps in releasing A from M.

To engage the boat the fore ring A must first be passed over M, then by slacking the after fall the after ring A can be slipped over E and the latter turned until it engages with P, when it can be locked in position by the forked pin E^2 and the boat hoisted.

It is claimed by the inventor that besides its general simplicity it has other advantages, viz. :—Practical impossibility of failure; working parts few and all in sight; the boat cannot be unshipped by a sea striking her bottom; the boat always takes the water stern first, and finally cannot be upset when hooking on, for if only one hook, which

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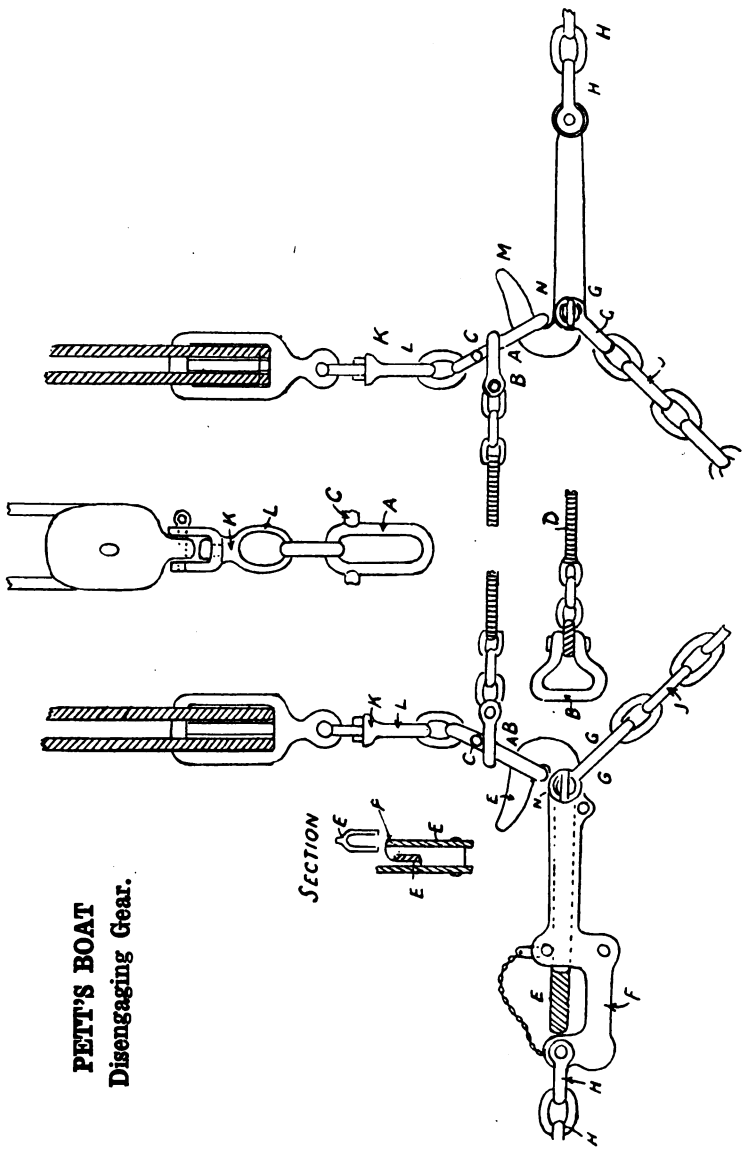

PETT'S BOAT
Disengaging Gear.

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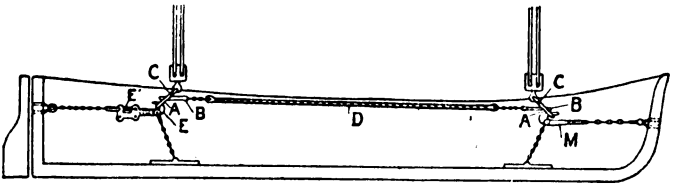
must be the fore one, is engaged, and the fall becomes taut, the ring will slip off the hook and release the boat.

Boat hung by Pett's Disengaging Gear.



Explanation of Sketches of Pett's Boat Disengaging Gear.

A.—Ring on lower block of boat's falls.
B.—Shackles on ends of wire fore and after.
C.—Lugs on the lower block rings A.
D.—Wire fore and after.
E.—After hook.
E^1.—Lever for tumbling after-hook.
E^2.—Forked pin for locking lever E^1.
F.—Plates forming frame between which the lever hook E is pivoted.
G.—Shackles connecting hooks E and M to keel slings.
$G.^1$—Pivot pin.
H.—Shackles connecting hooks E and M to slings to stem and stern posts.
H^1.—Chain slings to stem and stern posts.
J.—Chain slings to keel.
K.—Swivel shackle.
L.—Eye in shackle for life-line to reeve through.
M.—Foremost hook.
N.—Eyes for steadying lines.
P.—Projection preventing E^1 from moving upwards.

Sea Boats.

Two boats are kept ready for lowering at sea, one on either side, in the event of anyone falling overboard, or a boat being required quickly for any other purpose.

These boats are fitted with a disengaging gear for slipping the boat from the falls whilst the ship is still travelling through the water.

Two wire jackstays secured to a strop on each davit and to eye-bolts on the ship's side near the waterline with a lizard travelling on each and attended in the boat, are used as a means of steadying the boat on being lowered or hoisted. These lizards should on no account be hitched

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to the lower blocks of the falls, as the side stress may prevent the disengaging apparatus from clearing.

A boat rope is always used with the sea boat, and it is the duty of the coxswains to see it properly secured and in place. One end is secured inboard and well forward, the other to the bows of the boat, either by making a bowline in the end and passing it under the foremost thwart and up abaft it, and placing a stretcher through the bowline in a fore and aft direction and laying it on the two foremost thwarts (if required to tow the boat after slipping), otherwise by securing it to the lower block of the foremost fall.

The plugs of sea boats are always kept in, being removed only to clear the boat of water, and then immediately replaced. Extra life-lines, one to each thwart, are placed on the jackstay between the davits of the sea boat. The tiller is stopped over to the ship's side by a yarn to the hawse-rail. The falls are either flaked down clear for running or are reeled up on two reels, one to each fall.

A sea boat should contain :—

1 compass.
1 box biscuits.
2 water baricoes filled with fresh water.
1 sea boat's box, containing :—
4 short lights.
1 Very's pistol.
10 Very's lights (5 green and 5 red).
Lead and line.
Lantern and candles.
1 life-belt for each of the crew and the officer of the boat.

Lowering a Sea Boat.—On a sea boat's crew being called away they man their boat instantly and put on their life-belts. The life-lines are crossed to prevent the boat surging in a fore and aft direction, and the crew on the inside stand by with stretchers ready to bear the boat off from the ship's side. No one is to be abaft the after fall or before the foremost fall.

The lee boat is always the one to lower, and in a rough sea a good lee should be made and, if necessary, oil used before lowering the boat.

Sea boat lowerers, consisting of a leading hand and two others, are told off to each fall; the leading hand slipping the gripes (with a hammer specially supplied for the purpose and secured to the davit with a lanyard) before starting the falls.

The officer lowering the boat as she nears the water gives the order "Out pins," and then, watching his opportunity so as to drop the boat near the water, orders "Slip,"

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the coxswain slips (the inertia given the boat by the ship and the helm being over, she will sheer away from the ship), the crew at once get their oars out and give way.

Hoisting a Sea Boat.—A lee is formed, and as the boat approaches, the boat rope should be passed into her as soon as possible by means of a heaving line, and manned inboard, and when secured, the boat hauled under the davits; a stern line is also passed into the boat if necessary and secured.

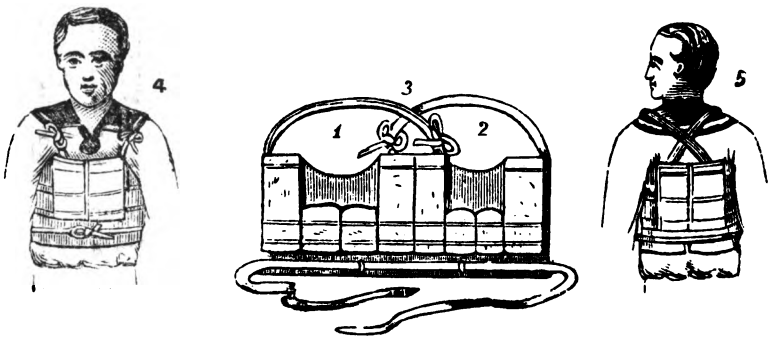
The foremost fall should be hooked on first, and then the after one, life-lines crossed, and stretchers used as in lowering. All the crew are hoisted in the boat, the falls being strongly manned.

When the boat is up and the falls secured, the crew get her weight off the pins by setting up the fore and after and griping her to, life-lines left clear and life-belts in place, tiller stopped over towards the ship, and boat-rope secured.

The coxswain reports to the officer of the watch that his boat is off the pins and ready for lowering. The falls are also reported "clear for running."

Life-belt.

On getting into the boat each man should put his life-belt on as quickly as possible, putting his right arm through shoulder-strap No. 1, and his left arm through shoulder-strap No. 2, dipping his head through the cross, No. 3, having the



corks outside; bringing the strings round and tying them in front, which will cause the belt to close.

Figure 4 shows the belt tied in front.

Figure 5 shows it as it appears behind.

The life-belts supplied to H.M. ships weigh five pounds, have a buoyancy of twenty pounds, and are capable of supporting one man.

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Management of Pulling Boats.

It is an old Service saying that a ship is known by her boats; therefore remember when away in a boat that you carry the credit of your ship with you, and strive to uphold it.

Always see the crew properly dressed, their shoes in the boat, and clothes and caps brushed, and the boat itself thoroughly clean and gear neatly stowed.

Never allow the crew to leave the boat at a landing-place or to lounge about in the boat, smoke, spit over the side, or behave in any way likely to bring discredit on their ship. Strict silence should always be maintained.

Always be sure you know your recall, and, knowing it, keep a look-out for it being hoisted.

Make sure you clearly understand your orders before shoving off. If sent to another ship with a message, or letter, deliver it personally to the officer of the watch or quartermaster.

If you have to wait, lay off, well clear of her quarter, unless permission is given you to make fast to the boom, and look out for a call alongside.

Never remain at the gangway, unless specially ordered to do so. Man your boat smartly when called away, and always pull your boat to and from the boom to the gangway; the guest warp is not fitted (though sometimes used) for the convenience of boats' crews manning their boats.

Never overload a boat. Heavy weights should be kept out of the extreme ends of a boat, but when running before a heavy sea, the best trim is deepest by the stern. Remember that if you are sent away in charge of a boat, you are responsible for her safety and that of her crew, and, in this, as in other matters, do not be afraid of exercising your responsibility, and do as *you* think right, and not as others suggest.

Learn "The Salutes in Boats," a copy of which is given in the signal chapter, and do not cross your superior's bows.

If at any time you are sent to bring off the Paymaster who has been drawing money, be careful to personally see the buoy and buoy-rope is made fast to the bag containing the money, so that in case of any accident to the boat the position of the money is known and can therefore be recovered. In coming alongside pass the buoy and buoy-rope inboard first.

Always sit down in a boat.

In anchoring, see the anchor properly stocked, the orelock in and the end of your grapnel secured before letting

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the anchor go, also sufficient grapnel clear to reach the bottom, and if anchoring on a rocky bottom bend the grapnel to the crown of the anchor and stop it to the ring; if in weighing the flukes catch in a rock, the stop carries away and the anchor comes up without difficulty, flukes up.

Always boat your oars in going alongside a vessel under way, or on any occasion in harbour when there is sufficient sea or swell to endanger an oar getting under a platform of the gangway and being forced through the bottom of the boat. Never allow your crew to pull in a slovenly manner. Be careful not to allow the boat to be bumped against the ship's side, gangways, or wharves by giving her too much way, but see that she is brought quietly alongside parallel to the ship. Plugs should be left out when boats are hoisted in harbour, but should be secured with a lanyard close to plug-hole, so that the plug is easily found if the boat is required after dark. On returning on board you should report anything you see wrong outside the ship.

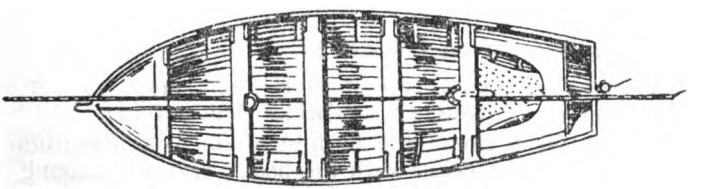
After hoisting, see your boat properly squared and all dirty marks wiped off, especially the waterline.

Towing.

When towing another boat make a bowline in her painter and secure it by passing it up between the two after thwarts and reeving a stretcher through it to act as a toggle.

When towed by another boat or a ship, secure the tow-line in the same way between the two foremost thwarts, or make a bowline in the end of your painter and reeve the painter under a stretcher between the two foremost thwarts and pass the bowline into the towing boat, the other end of the painter remaining shackled in its proper place. In both cases have a man standing by ready to slip.

When being towed astern of another boat the closer the better.



If a number of boats are being towed the largest and heaviest should be the foremost in the line; they can be secured by passing a hawser astern to which each boat is

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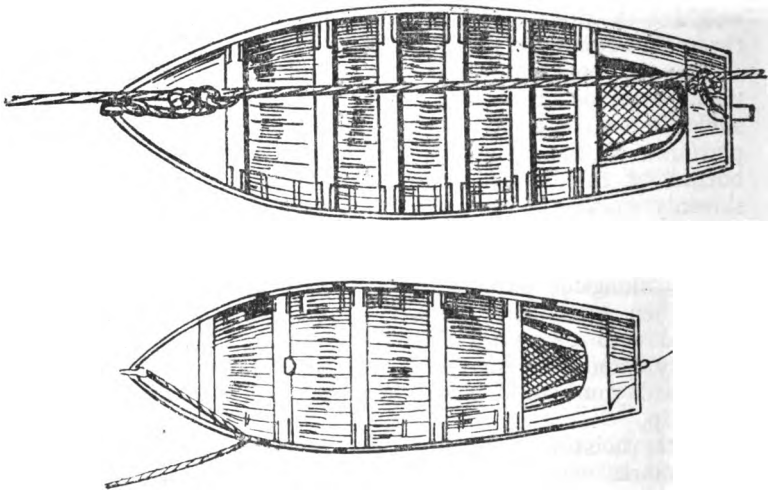
secured by hitching her bow and stern painters to it with a rolling hitch.



Towing alongside.

Tow a spar large end first, as it tows steadier and prevents the possibility of the hitch slipping off.

In laying out a hawser in smooth water, always see that you have sufficient end in the boat to give the bowman plenty of slack in hand to make fast with, while you keep the boat in position with the oars.

In laying out a hawser to windward, or against a strong tide, coil the whole of the hawser down in the boat, make the end fast to the object you are laying out to, and drop down again, paying out as you go.

If obliged to ride out a gale of wind in an open boat, make a sea anchor of the oars, barricoes, loosed sails, and other gear, launch it over the bows, with the boat's painter or grapnel secured to it (the longer the drift the better), and ride to it.

To haul a Boat up on a Beach :—

If possible procure two or more short spars to act as rollers, the boat's stretchers are better than nothing.

Form a strop round the bottom of the boat longitudinally by making a bowline with the boat's grapnel, hanging it from the sides to prevent it from slipping, and man the end. The boat's painter should not be used, as by hauling on a rope which is secured well up in the bows when the strain is taken, the tendency is to bring the bows of the

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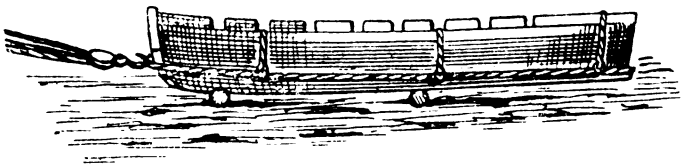
boat down into the sand or beach. Work the rollers as necessary.



Hauling a Boat up on a Beach.

Landing in a Surf.

Viewed from seaward, a surf has never so formidable an appearance as when seen from the land; men in a boat outside the broken water are therefore apt to be deceived by it. They should accordingly, if practicable, proceed along the land outside the surf, until abreast of a coastguard or lifeboat station, or fishing village, whence they might be seen by those on shore, who would then signal to them where they might attempt to land with safety, or else warn them to keep off; or who might proceed in a lifeboat or fishing boat to their aid, the generality of coast fishing boats being far better able to cope with surf than a ship's boat, and the coast boatmen being more skilful in managing boats in a surf than the crews of ships. If at night, double precautions are necessary, and it will generally be much safer to anchor outside the surf until daylight than attempt to land through it in the dark.

Where a surf breaks at only a short distance from the beach, a boat may be anchored outside the surf, and veered or backed in from her own anchor. In such a case care should be taken that the cable is of sufficient length to permit of the boat reaching the beach from a safe position outside the line of breakers. The cable should be bent and everything be in readiness for landing before approaching the shore; on reaching the edge of the breakers the bow oars should be laid in; on the anchor being let go, the rudder should be unshipped and the boat backed in steadily but fearlessly, the coxswain having a line ready for a sternfast, care being taken by the bowmen to keep the bow of the boat to the sea by not letting her take the cable too fast. On reaching the shore the coxswain should either jump overboard with the stern-fast or throw it to anyone who may be on the beach. The sternfast steadies the boat, keeps her bow to the sea, and facilitates the landing. On the landing being effected the boat can be hauled out to her

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anchor, taking care to leave the end of the sternfast on the beach if the boat is required to return to shore.

Going over a bar against a surf, avoid a heavy breaker if you can ; if not, " pull at it " with all your might, cautioning your men not to lose their oars.

Going in before a surf, watch your chance of a partial smooth, which generally occurs after a succession of heavy breakers.

When a breaker is overtaking you, there is generally no time to turn round bow on ; under these circumstances " back at it " with all your might, giving away again as soon as it has passed the middle of the boat.

The reason for pulling at, or backing at a surf, is to let it pass by as soon as possible, as the principal danger lies in being carried along with it.

When carried along with a surf the rudder is powerless, as the water is going with the boat. Hence the importance of a steer oar.

In Rowing to Seaward.

As a general rule, speed must be given to a boat rowing against a heavy surf. Indeed, under some circumstances, her safety will depend on the greatest possible speed being attained on meeting a sea. For if the sea be really heavy, and the wind blowing a hard on-shore gale, it is only by the utmost exertions of the crew that any headway can be made. The great danger is that an approaching heavy sea may carry the boat away on its front, and turn it broadside-on, or up-end it, either effect being immediately fatal. A boat's only chance in such a case is to obtain sufficient way to enable her to pass, end on, through the crest of the sea, and leave it behind her as soon as possible. Of course, if there is rather a heavy surf, but no wind, or the wind off-shore and opposed to the surf, as is often the case, a boat might be propelled so rapidly through it that her bow would fall more suddenly and heavily after topping the sea than if her way had been checked. Full speed should, however, be given to the boat when the surf is of such magnitude that there is a chance of being carried back before it.

It may also happen that, by careful management under such circumstances, a boat can be made to avoid the sea so that each wave shall break ahead of her, which may be the only chance of safety for a small boat ; but if the shore is flat, and the broken water extend to a great distance from it, this will often be impossible.

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The following general rules for rowing to seaward may therefore be relied on :—

1. If sufficient command can be kept over a boat by the skill of those on board her, avoid or "dodge" the sea if possible, so as not to meet it at the moment of its breaking or curling over.
2. Against a head gale and heavy surf, get all possible speed on a boat on the approach of every sea which cannot be avoided.
3. If more speed can be given to the boat than is sufficient to prevent her being carried back by a surf, her way may be checked on its approach, which will give her an easier passage over it.

On Running before a Broken Sea, or Surf, to the Shore.

The one great danger, when running before a broken sea, is that of *broaching-to*. To this peculiar effect of the sea, so frequently destructive of human life, the utmost attention must be directed.

The cause of a boat's broaching-to when running before a broken sea or surf is, that her own motion being in the same direction as that of the sea, whether it be given by the force of oars or sails, or by the force of the sea itself, she opposes no resistance to it, but is carried before it. Thus, if a boat be running with her bow to the shore, and her stern to the sea, the first effect of a surf or roller, on its overtaking her, is to throw up the stern, and as a consequence to depress the bow; if she then has sufficient inertia (which will be proportional to weight) to allow the sea to pass her, she will in succession pass through the descending, the horizontal, and the ascending positions, as the crest of the wave passes successively her stern, her midships, and her bow, in the reverse order in which the same positions occur to a boat propelled to seaward against a surf. This may be defined as the safe mode of running before a broken sea.

But if a boat, on being overtaken by a heavy surf, has not sufficient inertia to allow it to pass her, the first of the three positions above enumerated alone occurs—her stern is raised high in the air, and the wave carries the boat before it, on its front, or unsafe side, sometimes with frightful velocity, the bow all the time deeply immersed in the hollow of the sea, where the water, stationary, or comparatively so, offers a resistance, whilst the crest of the sea, having the actual motion which causes it to break, forces onward the stern or near end of the boat. A boat will in this

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position sometimes, aided by careful oar-steerage, run a considerable distance until the wave has broken and expended itself. But it will often happen that, if the bow be low, it will be driven under water, when the buoyancy being lost forward, whilst the sea presses on the stern, the boat will be thrown (as it is termed) end over end; or if the bow be high, or it be protected, as in most lifeboats, by a bow air-chamber, so that it does not become submerged, that the resistance forward, acting on one bow, will slightly turn the boat's head, and the force of the surf being transferred to the opposite quarter, she will in a moment be turned round broadside by the sea, and be thrown by it on her beam-ends, or altogether capsized. It is in this manner that most boats are upset in a surf, especially on flat coasts, and in this way many lives are annually lost amongst merchant seamen when attempting to land, after being compelled to abandon their vessels.

Hence it follows that the management of a boat, when landing through a heavy surf, must as far as possible be assimilated to that when proceeding to seaward against one, at least so far as to stop her progress shoreward at the moment of being overtaken by a heavy sea, and thus enabling it to pass her. There are different ways of effecting this object:—

1. By turning a boat's head to the sea before entering the broken water, and then backing in stern foremost, pulling a few strokes ahead to meet each heavy sea, and then again backing astern. If the sea be really heavy and a boat small this plan will be generally the safest, as a boat can be kept more under command when the full force of the oars can be used against a heavy surf, than by backing them only.
2. If rowing to shore with the stern to seaward, by backing all the oars on the approach of a heavy sea, and rowing ahead again as soon as it has passed to the bow of the boat, thus rowing in on the back of the wave; or, as is practised in some lifeboats, placing the after-oarsmen with their faces forward, and making them row back at each sea on its approach.
3. If rowed in bow foremost, by towing astern a pig of ballast or large stone, or a large basket, or a canvas bag, termed a "drogue" or drag, made for the purpose, the object of each being to hold the boat's stern back, and prevent her being turned broadside to the sea or broaching-to.

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A boat's sail bent to a yard and towed astern loosed, the yard being attached to a line capable of being veered, hauled, or let go, will act in some measure as a drogue, and will tend much to break the force immediately astern of the boat.

Heavy weights should be kept out of the extreme ends of the boat; but when rowing before a heavy sea the best trim is deepest by the stern, which prevents the stern being readily thrown on one side by the sea.

A boat should be steered by an oar over the stern or on one quarter when running before a sea, as the rudder will then at times be of no use. If the rudder be shipped, it should be kept amidship on a sea breaking over the stern.

The following general rules may therefore be depended on when running before or attempting to land, through a heavy surf or broken water:—

1. As far as possible avoid each sea by placing the boat where the sea will break ahead or astern of her.
2. If the sea be very heavy, or if the boat be very small, and especially if she have a square stern, bring her bow round to seaward and back her in, rowing ahead against each heavy surf that cannot be avoided sufficiently to allow it to pass the boat.
3. If it be considered safe to proceed to the shore bow foremost, back the oars against each sea on its approach, so as to stop the boat's way through the water as far as possible, and if there is a drogue, or any other instrument in the boat which may be used as one, tow it astern to aid in keeping the boat end-on to the sea, which is the chief object in view.
4. Bring the principal weights in the boat towards the end, that is to seaward, but not to the extreme end.
5. If a boat, worked by both sails and oars, be running under sail for the land through a heavy sea, her crew should, under all circumstances, unless the beach be quite steep, take down her masts and sails before entering the broken water, and take her to land under oars alone, as above described. If she have sails only, her sails should be much reduced, a half-lowered foresail or other small headsail being sufficient.

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Beaching or Landing through a Surf.

The running before a surf or broken sea, and the beaching or landing of a boat, are two distinct operations. The management of boats as above recommended has exclusive reference to running before a surf where the shore is so flat that the broken water extends to some distance from the beach. Thus, on a very steep beach the first heavy fall of broken water will be on the beach itself, whilst on some very flat shores there will be broken water as far as the eye can reach, sometimes extending to even four or five miles from the land. The outermost line of broken water, on a flat shore, where the waves break in three and four fathoms water, is the heaviest, and therefore the most dangerous, and when it has been passed through in safety, the danger lessens as the water shoals, until, on nearing the land, its force in spent and its power harmless. As the character of the sea is quite different on steep and flat shores, so is the customary management of boats on landing different in the two situations. On the flat shore, whether a boat be run or backed in, she is kept straight before or end-on to the sea until she is fairly aground, when each surf takes her further in as it overtakes her, aided by the crew, who will then generally jump out to lighten her, and drag her in by her sides. As above stated, sail will in this case have been previously taken in if set, and the boat will have been rowed or backed in by oars alone.

On the other hand, on the *steep* beach, it is the general practice, in a boat of any size, to retain speed right on to the beach, and, in the act of landing, whether under oars or sail, to turn the boat's bow half round towards the direction from which the surf is running, so that she may be thrown on her broadside up the beach, where abundance of help is usually at hand to haul her as quickly as possible out of the reach of the sea. In such situations, we believe, it is nowhere the practice to back a boat in stern foremost under oars, but to row at it under full speed, as above described.

Boarding a Wreck, or a Vessel, under Sail or at Anchor, in a Heavy Sea.

The circumstances under which boats have to board vessels, whether stranded or at anchor, or under way, are so various that it would be impossible to draw up any

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general rule for guidance. Nearly everything must depend on the skill, judgment, and presence of mind of the coxswain or officer in charge of the boat, who will often have those qualities taxed to the utmost, as undoubtedly the operation of boarding a vessel in a heavy sea or surf is frequently one of extreme danger.

It will be scarcely necessary to state that, whenever practicable, a vessel, whether stranded or afloat, should be boarded to leeward, as the principal dangers to be guarded against must be the violent collision of the boat against the vessel or her swamping or upsetting by the rebound of the sea, or by its irregular direction on coming in contact with the vessel's side; and the greater violence of the sea on the windward side is much more likely to cause such accidents. The danger must, of course, also be still further increased when the vessel is aground and the sea breaking over her. The chief danger to be apprehended on boarding a stranded vessel on the lee side, if broadside to the sea, is the falling of the masts, or, if they have been previously carried away, the damage or destruction of the boat amongst the floating spars and gear alongside. It may, therefore, under such circumstances, be often necessary to take a wrecked crew from the bow or stern; otherwise a rowing-boat, proceeding from a lee shore to a wreck, by keeping under the vessel's lee, may use her as a breakwater, and thus go off in comparatively smooth water, or be at least shielded from the worst of the sea. If unable to approach a wreck in the manner above described, anchor to windward of the stranded vessel, and then veer down to 100 or 150 fathoms of cable, until near enough to throw a line on board. The greatest care, under these circumstances, has, of course, to be taken to prevent actual contact between the boat and the ship; and the crew of the latter has sometimes to jump overboard, and be hauled to the boat by ropes.

In every case of boarding a wreck or a vessel at sea, it is important that the lines by which a boat is made fast to the vessel should be of sufficient length to allow of her rising or falling freely with the sea; and every rope should be kept in hand ready to cut or slip it in a moment if necessary. On wrecked persons or other passengers being taken into a boat in a seaway, they should be placed on the thwarts in equal numbers on either side, and be made to sit down. All crowding or rushing headlong into the boat should be prevented, as far as possible; and the captain of the ship, if a wreck, should be called on to remain on board to preserve order until every other person has left her.

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Watering Ship with Boats.

Water can be brought off in canvas tanks (supplied for the purpose), in bulk, or in casks.

The canvas tanks are made in two halves; they are placed under the thwarts and stopped up to them. They can be filled with hoses.

If the water is brought off in bulk, the boat should be previously washed out with fresh water. Small quantities should be brought off in this manner if there is any chance of the sea-water washing into the boat.

If watering with casks it is advisable to fill the casks in the boat.

BOAT SAILING.

Parts of a Sail :—

Head.—The upper edge of a sail.

Luff.—The foremost edge of a sail.

Leach.—The after edge of a sail.

Foot.—The lower edge of a sail.

Throat.—The upper foremost corner.

Peak.—The upper after corner.

Tack.—The lower foremost corner.

Clew.—The lower after corner.

Cringles of various sizes are worked into the corners of the sails, and at each end of each reef.

Eyelet-holes are worked into the head of sails, for bending the sails to the yard or gaff.

Reef Points.—Are pieces of line worked into and through the sail for stopping up reefs.

The following illustrations will help to explain above :—

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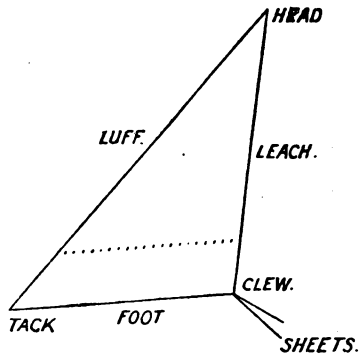

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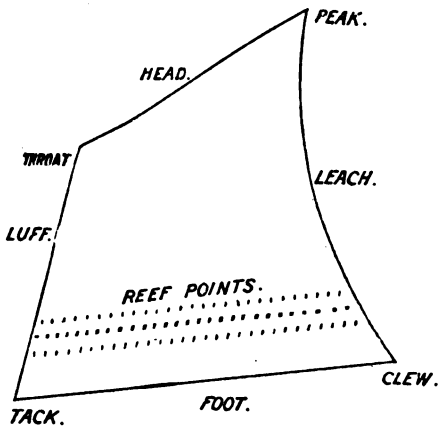
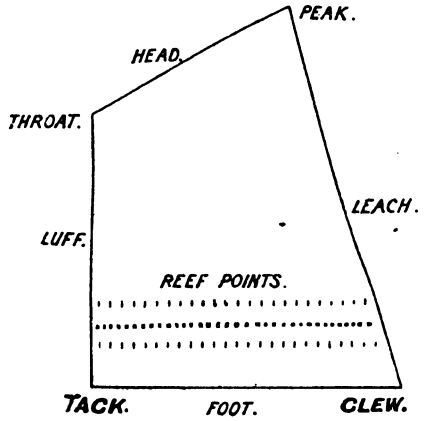
LUGSAIL.



MAINSAIL.



Definitions.

Luff.—Is to let the boat come to the wind by easing the helm down.

Bear up or keep away.—Is to let the boat go more off the wind by putting the helm up.

Heave to.—Is to keep the boat as near the wind and as stationary as possible.

Check.—Is to ease away.

Settle.—Is to lower.

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Full and bye.—Is to sail the boat as near the wind as possible while keeping the sails full.

Running Free.—Is sailing with the wind abaft the beam.

Weather Helm.—A boat is said to carry weather helm if the tiller has to be kept to windward to keep the boat from coming up to the wind. A boat may be made to carry weather helm by moving the crew or ballast further forward.

Lee Helm.—A boat is said to carry lee helm if the tiller has to be kept to leeward to keep the boat to the wind. A boat carries lee helm by having the crew or ballast too far aft.

A boat should always be trimmed to carry a little weather helm.

Ready About.—Is to prepare to tack.

Let Draw.—Is to let go the weather sheet after tacking (or after it has been hauled to windward) and hauling aft the lee sheet.

In Irons.—A boat is said to be in irons, when up in the wind she will not pay off on either tack.

Leeway.—The drift a boat makes when sailing near the wind.

To Weather.—To pass on the windward side of an object.

Shorten Sail.—To take in sail.

Set.—To hoist or make sail.

Method of Bending and Bringing to Boats' Sails.

Secure the throat of sail to yards with a good seizing.

Haul the head of the sail out taut, roping against the yard, and secure the peak with a good seizing.

The sail is then brought to with lacing (which should be about twice the length of the yard). The centre of the lacing should be spliced into the centre eyelet-hole of the head of the sail, and the lacing to the yard should be performed towards the peak and the throat at the same time.

The lacing should be passed as follows :—

Pass the end of the lacing over the yard and then back through the same eyelet-hole, so that when hauled taut it will form a half hitch ; then carry lacing along the head of the sail through the next eyelet-hole, then over the yard again and back through the same eyelet-hole, and so on, finishing off at the peak and throat with two half hitches.

In bending launches' and pinnaces' sails the lacing is passed around the gaff and the half hitch is not formed.

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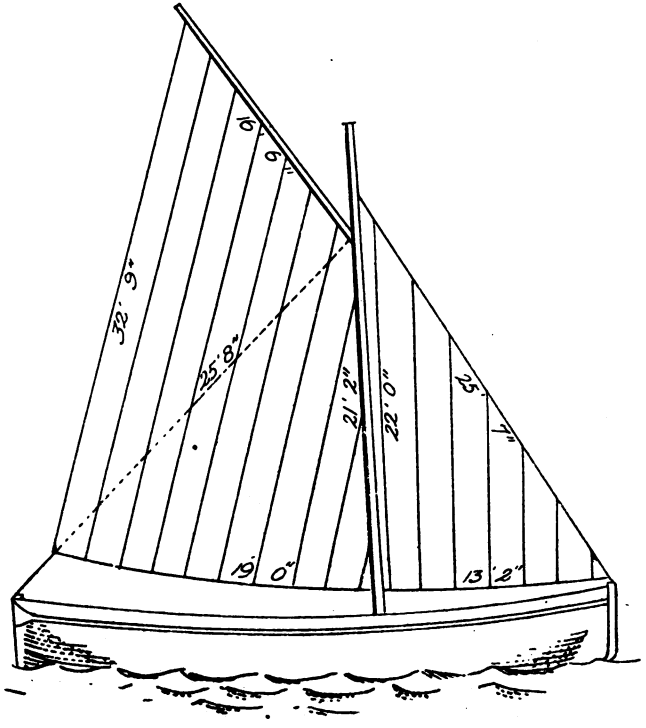
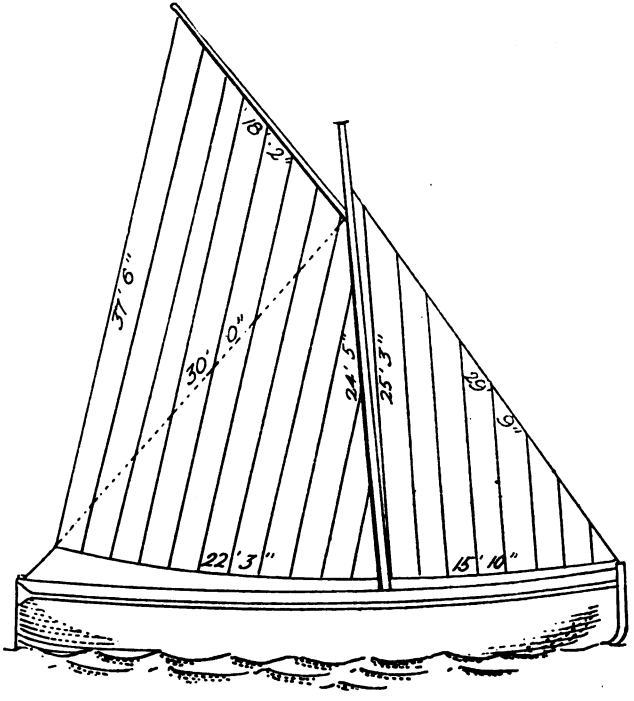
36 ft. Pinnace.



42 ft. Pinnace.



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Hanks are seized in the luff of the foresail through which the forestay passes.

Care must be taken when bending new sails that the head is not hauled too taut, and the lacing must be moderately slack. New sails should never be hoisted taut until they have been used half a dozen times.

Launches and Pinnaces.

The Service rig for these boats is known as the De Horsey rig, and consists of one mast with a gaff, mainsail and staysail (or foresail). These boats are necessarily slower in making sail and in shortening sail, and getting their masts up and down than a dipping lug cutter; but the rig is an exceedingly handy one, and in fine weather the boat can be easily worked with a crew of six men and a coxswain.

The rigging consists of a forestay, which is of wire, and should be fitted sufficiently long to reeve through the roller in the bow of the boat when the mast is down, and launched sufficiently far aft for putting the upper pin in place.

Two wire shrouds, one each side, which are set up to the shroud plates abreast the mast with lanyards. Two hemp shrouds, one each side, fitted with a runner and tackle. The standing part of the runner is clip-hooked to the shroud plate abaft the wire shroud, and the tackle to a shroud plate abaft that again, and so acts as a backstay to the mast.

The foresail is a jib-headed sail, either laced or secured with hanks to the forestay, hoisted by halliards, the tack secured to the bow of the boat, and fitted with double sheets.

The head of the mainsail is laced to the gaff, the luff secured to rings travelling up and down the mast, and the tack secured either with a tack lashing or tack tackle.

To Step the Mast.—In fine weather this can be done quickly as follows :—Launch the mast aft and put the upper pin in clamp on stem-piece, reeve forestay, and hook one end of main tackle to an eye-bolt well aft and bring the other end to the forestay, lift the head of the mast and haul on main tackle ; guide pieces fitted each side of the carlings to the step prevents the mast from swaying about. As soon as the mast is up, put in the lower pin, then clear away the gear and set up the shrouds. Clear away and bend on sails. If the weather is rough the mast is got up with the runners and tackles which are taken forward on each bow ; having a small amount of spread, they tend to keep the mast steadier.

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Making Sail.—In setting the mainsail the gaff should be hoisted up practically square, the throat halliards boused well up, and then the sail peaked until the sail girts slightly. The tack lashing or tackle should be secured before hoisting the gaff. *It is essential that the throat halliards should be well up;* nothing looks worse than sailing about with a slack luff, added to which the boat will not sail nearly as well. The staysail (or foresail) halliards should also be well taut.

Tacking.—This is a fairly simple matter. Keep the boat slightly off the wind to gather good way, and then gradually ease the helm down; do not check the fore-sheet (as is so often done, and then bearing it out to windward), but let the boat sail round, and fore-reach as much as possible, when head to wind and sails flapping, haul the old lee foresheet well aft and check the mainsheet slightly, the foresail will then take aback and pay the boat's head off on the new tack. Do not "let draw" the foresheet until the mainsail is full on the new tack.

Wearing.—Put the helm up and check the sheets. If the wind is light as the boat comes nearly stern to wind, gather in the mainsheet, and as the stern passes the wind, ease the mainsheet off quickly. Shift over the foresheet just before the stern passes the wind. As soon as the mainsail is full on the other track, haul aft the mainsheet. *If the breeze is at all fresh the mainsail must be brailed up as the wind comes on the quarter,* manning the lee brails best, which will gather in the sail; otherwise the sail will form in a bag and may carry the jaws of the gaff away in gibing. As soon as the wind is on the opposite quarter, re-set the mainsail and haul aft the sheets.

If wearing short round to come alongside, it is advisable to take the foresail in before the wind is right aft, as the mainsail will take the boat round with sufficient way, and the foresail would only tend to keep the boat off the wind.

Reefing.—*Luff the boat up to spill the sails.* Settle the foresail and throat halliards, hook the tacks to the reef cringles, and the sheets to the reef sheet cringles, gather in the sails and pass the reef points. It is advisable to reef the sails together rather than to take two reefs in the mainsail and none in the foresail, as the boat would tend to carry lee helm and bury her bow.

Notes.—When coming alongside on a wind, take in the foresail as the boat commences to shoot up, but not before; although a boat will run without headsails, on a wind she becomes unmanageable. *Keep a look-out on*

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the mast, as being high it will catch a davit, or a boat hoisted up. If sailing out to the lower boom to make fast, *have a hand stationed to ease the forestay* if the boat should have too much way, so as to bring her up gradually.

It is always advisable to have plenty of ballast; in a strong breeze two rum casks lashed just abaft the mast, in addition to the boat's breakers, will be found advantageous. These boats become very hard to handle in a strong breeze if they are not properly ballasted, as, being flat bottomed, they are blown bodily to leeward, and will continually miss stays in tacking, through being unable to carry their way through the water.

They are supplied with chain cables instead of a grapnel, the inboard end of which should always be secured to the ring bolt in the bottom of the boat; it is also advisable to keep the other end shackled on to the anchor.

A boat filled with liberty men or stores will carry a great deal of way, and when running into a pier or camber it is advisable to carry two buckets aft attached to lines which can be thrown overboard and act as a "drogue," in case of having too much way. Many piers and wharfs have no projections for boat-hooks or hook-ropes, and, therefore, it may be difficult without the use of the buckets to bring the boat up opposite the landing steps.

When necessary to lower the mainsail *let go the throat halliards first* and then the peak. The sail in all probability will not come down if the peak halliards are let go before the throat halliards are lowered.

In taking in the mainsail blowing hard, *man the lee brails best as it spills the sail.*

When leaving the ship to go round the stern, shove off under the foresail and wear short round, setting the mainsail, when it will take on the right tack.

Stations for making Sail in a 42-foot Launch.

Sail in a launch is usually made at the lower boom. The crew consists of a coxswain and 18 men told off as follows:—

Foremost thwart	–	Nos. 1 and 2 (bowmen).
2nd thwart –	–	Nos. 3 and 4, &c.

All hands clear away, 1st and 2nd thwarts man forestay (purchase).

All remainder gather round mast and lift up.

3rd thwart look out for pointing in shoe, and clamp it.

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As soon as Mast is up.

1st and 2nd thwart see jib clear for hoisting.
3rd and 4th, set up shrouds.
5th and 6th, set up runner and tackle.
7th and 8th, coil down all gear and see ready for making sail.
9th, see the sheet clear and put double block on hawse.

To make Sail.

1st thwart, look out to see jib clear when hoisted.
2nd and 3rd, hoist jib when ordered.
4th, attend sheets (jib) either side.
5th and 6th, on peak halliards } hoist mainsail.
7th and 8th, on throat halliards }
9th, look out for sheets.

To shorten Sail.

Same Nos. haul down jib as in setting.
Men on 5th, 6th, 7th, and 8th thwarts man brails according to side required.
9th, attend sheets.

Dipping Lug Cutters.

The dipping lug foresail and boom mainsail is an excellent rig for a cutter, but for larger open boats it is not recommended on account of the difficulty in handling the large foresail. It is not advisable to set any sail before the dipping lug; even if a small jib was set rigged well out, the back wind from it would so affect the sail that it would not pull its best, and the small advantage gained by the jib would not be compensated for in the loss that would occur through the dipping lug not being able to pull to its full extent. These boats are not easily "hove-to," but by hauling the main sheet well aft and checking the foresheet, and keeping the helm slightly down, they can be kept fairly stationary, care being taken not to allow the boat to get "in irons"; should this occur, by bearing out the foresail before the mast to windward she will in all probability pay off from the wind.

Shoving off and making Sail.—See all poppets shipped, sails placed on the right side of the boat, and the rigging, and halliards cleared away from the mast, and the boat properly ballasted for the strength of the wind. Launch the foremost aft and the mainmast forward so that the heels are over the tabernacles, then "up masts" together, set up the weather fore-shroud, both main-shrouds and

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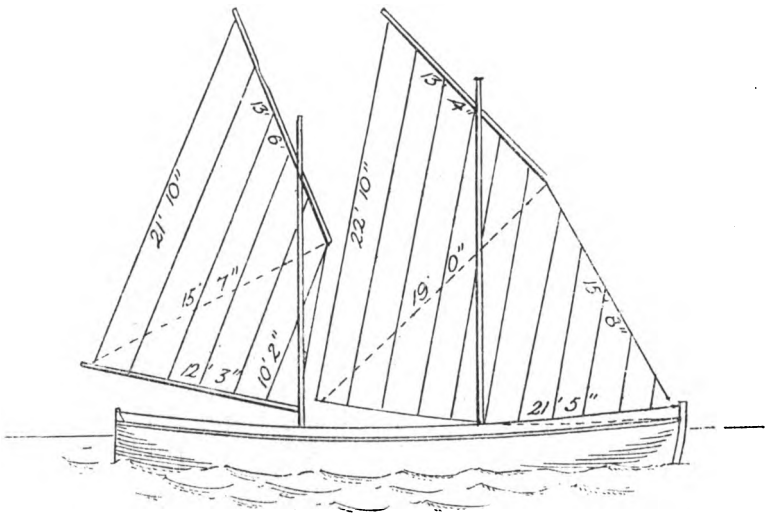
DIPPING LUG CUTTERS.

34 ft. Cutter.



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mainstay. Hook off the sails, haul out main outhaul and hoist the mainsail, and then top up the main boom; see fore halliards and sheets clear, then :—

Shove off, in fenders, and hoist the foresail, when the luff is well taut and the sail shows a crease from the tack to the after yard-arm, belay the fore halliards and haul aft the foresheet as requisite and keep it in hand. Set the mainsail as soon as the foresail is full.

Tacking.—*Keep the sails well full and get good way on the boat,* then order "Ready about," ease the helm gently down and haul aft the mainsheet; the bowmen move forward ready to unhook the tack. It should not be necessary to bear out the foresail at all, but if from a choppy sea or other cause the boat is not likely to sail round, the lee bowmen should bear out the foot of the sail when nearly head to wind; by this means the sail is taken aback and helps to pay the boat's head off on the new tack. It is not unlikely in adopting this method that the boat will gather sternway, *in which case the helm should be immediately put over the other way, and, if necessary, move the men aft to the old weather quarter,* which will lighten the bow and with the pressure of water on the immersed quarter will assist the boat round.

When it is seen that the boat will pay off on the new tack, lower and dip the foresail and ease off the mainsheet.

To Lower and Dip.—The foresail is lowered by the men on the thwart abreast the halliards sufficiently far to enable the fore yard-arm to be dipped abaft the mast (a small line called a dipping line is secured to the fore end of the yard) by the men on the midship thwart hauling on the dipping line, and the men on the 2nd bow thwart hauling down on the luff of the sail at the right moment; the bowmen unhook the tack, dip it round abaft the mast and hook it on again, the foresail is rehoisted and reset and the mainsheet hauled aft.

As the boat comes to the wind the lee shroud is set up, and as she pays off on the new tack the old weather shroud is let go and the lanyard overhauled.

The dipping line which is now to leeward of the sail is dipped round to windward. It is customary to have a mark on the halliards at the position at which the sail is low enough for dipping, and if a turn is taken at this mark the halliards can be let go at the order "Lower and Dip"; this quickens the evolution as it prevents the sail being lowered unnecessarily far; on no account should the foresheet be eased as the boat comes to the wind, as it only takes the way off the boat and helps to make her miss stays.

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Wearing.—This is the opposite operation to tacking. In tacking, the boat is brought from one tack to the other by sailing her head past the wind; in wearing, the boat is brought from one tack to the other by sailing her stern past the wind, the helm is put up and the sheets eased off. *As the wind draws nearly aft top up the mainsail* and lower and dip the foresail, and as the wind comes on the opposite quarter reset the mainsail, bring the boat to the wind by gathering in the mainsheet, and then haul aft the foresheet. In a light breeze the mainsail need not be topped up, but the sheet should be gathered in as the wind draws aft on the quarter, and eased off quickly as the stern passes the wind. In anything but a very light breeze it is advisable to top the mainsail up, it being safer, and saves bringing an unnecessary strain on the gear.

It is important to be in time with the foresail, as it is a difficult matter to dip the sail if it is aback.

Running.—When running with the wind well abaft the beam the tack of the foresail should be shifted from the tack hook in the stem to the running hook on the bow.

Reefing.—*Luff the boat sufficiently to spill the sails,* then settle the halliards, shift the tacks and sheets to the next cringles, and gather up the foot of the sails and tie the reef points (the sails should not be rolled up as they would form a receptacle for water), and then rehoist the sails.

Reefs are shaken out in a similar manner by settling the halliards, shifting the tack and sheet hooks to next cringle down and casting off the reef points, or the reef points may be cast off first, and then settle the halliards to shift the tack and sheet hooks. Reset the sails.

Always reef in good time. A good guide to reef is as soon as water begins to come in over the lee gunwale.

Never allow the crew to stand up whilst reefing.

It is unnecessary to carry more sail in a boat than is safe under existing conditions of wind and weather, and a boat does not sail any the better for it.

A heavily laden boat should be under oars if there is any breeze, or else well reefed down.

Coming alongside.—It is not possible to give definite rules for coming alongside well, as this is a matter depending on the skill and judgment of the coxswain, who must take into consideration the existing conditions of wind and weather, and the sailing qualities of his boat, which latter are greatly governed by the load she is carrying.

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When, however, the boat is nearing the gangway, see the crew at their stations and lower the foresail in good time. Haul aft the mainsheet as you put the helm down, and as soon as the boat is alongside top up the mainsail.

The foremast should be got down as soon as the foresail is lowered or it may foul a boat at the davits, the mainmast as soon as alongside, if not going to shove off again under sail. The fenders should be put out before lowering the foresail. If coming down with a fair wind *a good sweep should be made* so as not to have to round up too abruptly. If running alongside a pier or camber, sail should be shortened in plenty of time, and have either a sternfast or drogue ready; if possible, always go the lee side of a pier.

Stations for making Sail in 12-oar Dipping Lug Cutter.

The crew consists of 12 men and a coxswain told off as follows:—

Foremast thwart	–	–	Nos. 1 and 2 (bowmen).
2nd ,,	–	–	Nos. 3 and 4.
3rd ,,	–	–	Nos. 5 and 6.
			&c., &c.

Up Masts and making Sail:—

(1) Ship all poppets and place sails on proper side.

(2) Step masts. Crew on starboard side lift foremast, launching it aft until heel is in line with tabernacle; crew on port side lift mainmast, launching it forward until heel is in line with after tabernacle. Then, up masts together, Nos. 1 and 2 (in the case of the foremast), and Nos. 11 and 12 (in the case of the mainmast); man the shrouds and bear down and guide the respective heels into the tabernacles, clamping and putting pins in as soon as mast is stepped.

(3) Clear away rigging and sails:—

Nos. 3 and 4, all rigging on foremast; set up weather shroud.

Nos. 11 and 12, assisted by coxswain, all rigging on mainmast; set up shrouds and stay.

Remainder—Clear away and uncover sails their respective sides.

Then:—Bowmen hook tackle of foresail to stem of boat.

Nos. 3 and 4.—Hook foresail to traveller.

Nos. 9 and 10.—Hook on and attend foresheet.

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Nos. 11 and 12 and Coxswain.—Hook on mainsail, haul out outhall, hoist mainsail, and top up main boom.

Remainder—Man fore halliards.

When ready, shove off, in fenders, and hoist foresail. When boat's head has paid off set mainsail (men on after thwart easing down topping lift, and hauling aft mainsheet), then trim sails.

Nos. 4 and 5.—See dipping line clear, and attend it.

Lower and Dip :—

Nos. 7 or 8 (4th thwart)	– Lowers the foresail sufficiently to dip the sail.
Weather bowman –	– Unhooks tack of foresail, passes it round abaft the mast, and hooks it on again.
Nos. 5 or 6 (3rd thwart)	– Hauls on the dipping line, so as to cant the yard up and down the mast, and round to the opposite side.
Nos. 3 and 4 (2nd thwart)	– Attend the shrouds, setting up what was the lee shroud, and letting go the former weather one as soon as the boat is round.
Nos. 9 and 10 (5th thwart)	– Shift over the foresheet.
Men not employed –	– Hoist foresail.

Dipping Lug Foresail and Mizen.

The remarks on the handling of the dipping lug foresail and boom mainsail apply equally to the dipping lug foresail and mizen, the only difference being in reefing and shaking out reefs, when the mizen should be lowered down altogether and reefed (or reefs shaken out) in the boat, and the sail then reset.

The fittings of the mizen-mast and sail are practically identical with the standing lug mainsail, but as the mast steps up and down the transom, instead of at the after thwart, a boomkin is fitted for the boom sheet to hook to.

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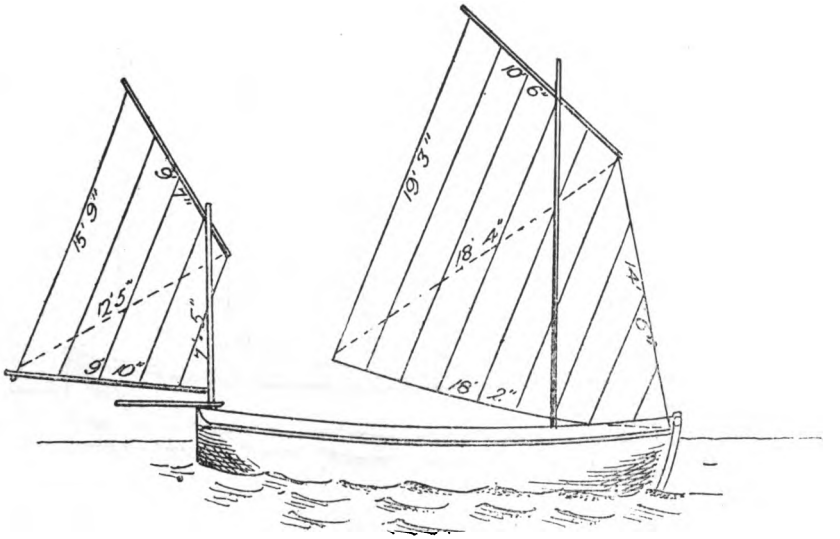
[*To face page* 246.

DIPPING LUG FORSAIL AND MIZZEN.

26 ft. Cutter.



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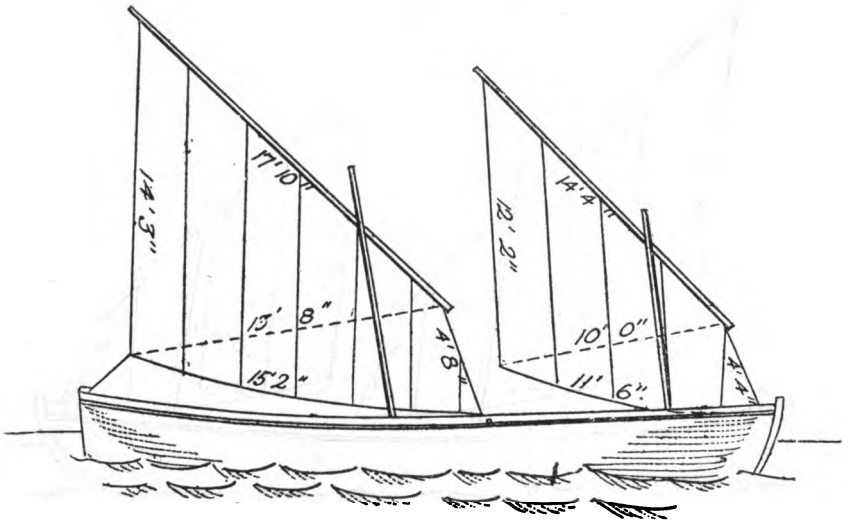
30 ft. Gig.



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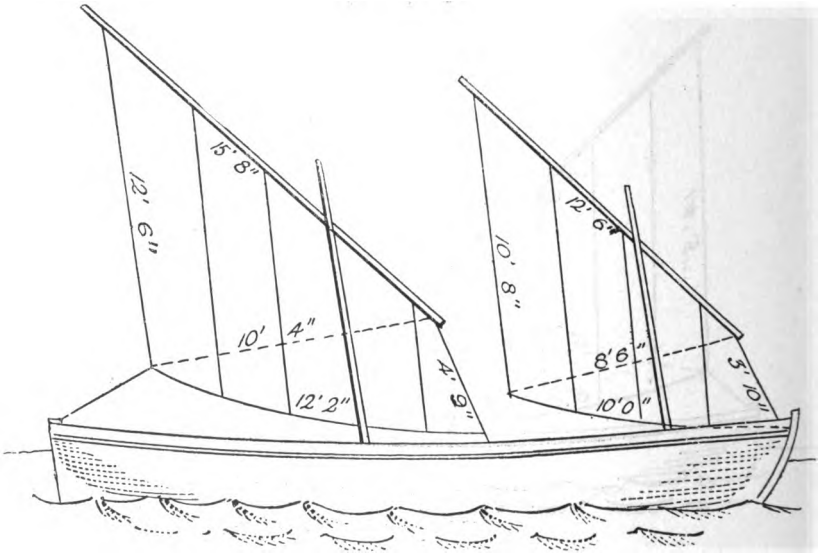
27 ft. Whaler.



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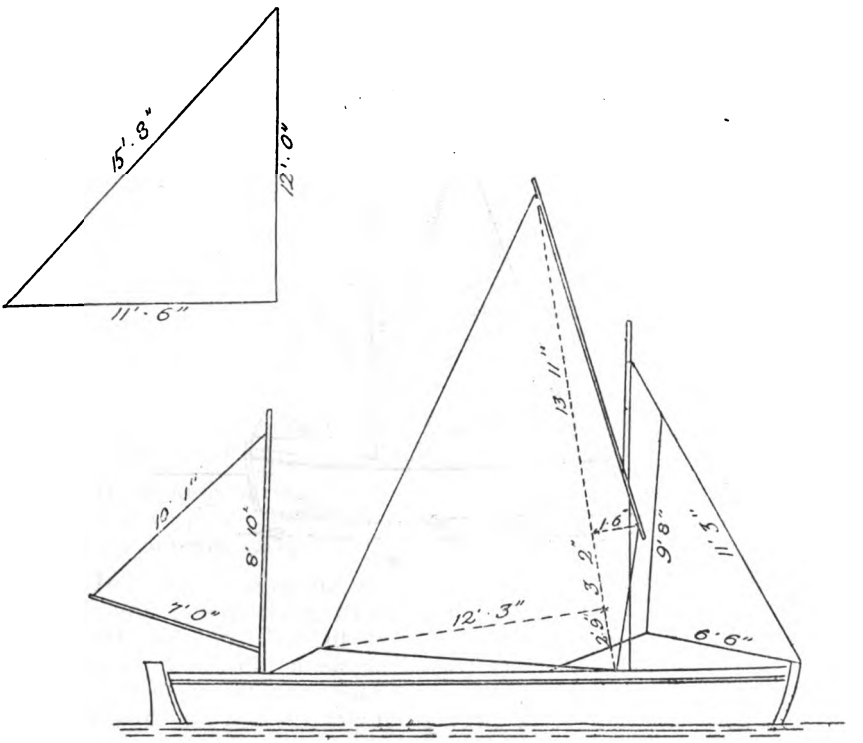
(MONTAGU BOAT.)

27 ft. Whaler.

Sail Plan.

Trysail to act as Spinmaker also.



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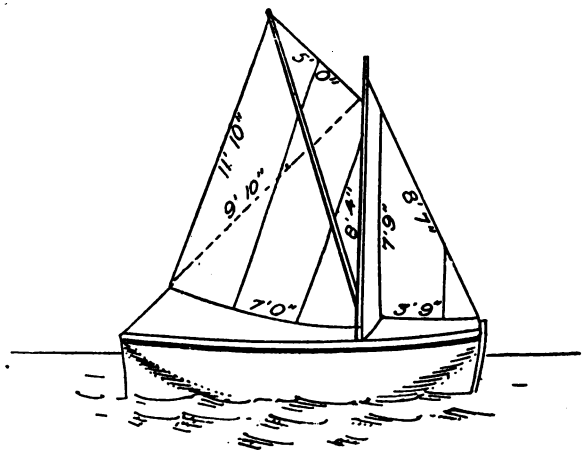
13½ ft. Dingy.



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The boomkin is a short piece of wood resting in and clamped down to the transom, which is hollowed out to take it. The inner end fits into an iron swivel clamp, which is secured to the rail.

The mizen-sheet reeves through a block at the outer end of the boomkin, and is led into the stern of the boat.

Gigs and Whalers.—The sails are bent to the yards in the same way as in a cutter.

The tacks are secured by a piece of rope reeving through a block in the bottom of the boat and hooked to the tack of the sail, with a small purchase on the inboard end.

In setting the sails hoist them well up *first* and then bouse the tacks well down.

In tacking, the sails are not lowered, the tack is let go at the order "Dip," and is unhooked from the sail, the foremost yard-arm is then dipped round abaft the mast, and the tack rehooked, and then boused well down again. The same is done in wearing, the sheets being gathered in before the wind is right aft and eased off quickly as the sails are dipped.

Spreaders are used when running to keep the clews of the sails well out.

If running with the wind aft, the sails can be goose-winged, *i.e.*, the sails set on opposite tacks with the spreaders out on opposite sides.

It is a very snug rig when reefed down. A spare mast-hole and tabernacle is fitted in the centre of the fore and aft thwart, so that in bad weather one mast can be stepped there and a single lugsail carried. Wash strakes are fitted round the boat for sailing, to give a higher freeboard and prevent taking in water as soon as she otherwise would.

Tillers are fitted for sailing, and it is advisable to use them in preference to sailing the boat with a yoke and lines.

Dingy and Skiff Dingy.—These boats are fitted with a jib and spritsail with the exception of the 10-foot dingy, which is fitted with a single lugsail.

It is a convenient and useful rig for dingies with good beam. The spritsail is a good powerful sail, and so long

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as the sail and sprit are not too large it is a convenient rig; its great objection is the difficulty of reefing. If blowing hard the only plan is to take the sprit out altogether, but this is inclined to render the boat unmanageable.

The snotter supporting the heel of the sprit should be made of wire and be strong, as if it carried away in a decent breeze the sprit is liable to go through the bottom of the boat.

The single standing lug is not a very good rig, it is not a weatherly sail, nor is it a particularly good lifting one.

Hints on Boat Sailing.

Never allow the crew to stand on the thwarts or climb the masts. The proper place for a boat's crew under sail is in the bottom of the boat and abaft the foremast. See your boat is properly ballasted according to the weather before you shove off; it is a much more simple operation to start ballast than to take it in when once under sail.

The only ballast that should be carried in a service boat is wood, or water in casks or barricoes.

Be careful to see the sails properly trimmed with respect to the wind; a boat will not sail on a wind with the sheets eased off, nor will she run with them flat aft. *When on a wind the sails should be set as flat as possible, the halliards taut up,* and in smooth water the sheets well aft and the after leech taut; a bag in the after leech will form a back sail and impede the boat's progress. Absolutely new sails should not be bent or set taut until they have been stretched. A lugsail should be brought to the yard straight along on the underneath side of it, and the thimble of the yard stop kept opposite to the head of the sail.

It is most important that sails should be properly set; if they are not, they should be reset at once. Nothing looks worse or is more unseamanlike than badly set sails, added to which the boat cannot sail properly.

In resetting sails the sheets must be eased until the halliards are properly up and secured, and if resetting on a wind the boat should be luffed up to spill the sail.

The proper distance for the strop of a dipping lug is one-third from the foremost yard-arm and a standing lug

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one quarter. The strop of a lugsail in the wrong place is the most common cause of a badly set sail; they are not permanent fittings and should be moved either in or out as necessary.

Oars should not be used under sail if it can be avoided. There is always a danger of the lee oars catching in the water and splitting the gunwale or capsizing the boat.

If the wind falls get the masts down at once, and the oars out; it looks very bad to see a boat drifting aimlessly about under sail waiting for a breeze.

When sailing by the wind keep the luff of the foremost sail just touching but not shaking. It requires great art and skill to get as much out of a boat on a wind as it is possible; the strictest attention is required, as *every little puff should be taken advantage of by slightly luffing to it.* The point to be aimed at in sailing by the wind is to go as fast as possible and as close to the wind as possible, but this by no means is to haul the sheets flat aft and jamb the boat up in the wind. The trim of the sheets requires very close attention; the sheet of a standing lug, for instance, can be hauled flatter aft than that of a dipping lug, and in smooth water the sheets can be hauled flatter aft than in rough water. In sailing by the wind in a rough sea it is advisable to luff to a big wave so as to avoid filling the boat with water, putting the helm up again immediately the wave has passed and filling the sails again. When running, the tack of the foresail in a dipping lug cutter is hooked to the weather bow instead of to the stem; this also applies to gigs and whalers.

When running in a rough sea with the wind on the quarter it is advisable, when a heavy sea is coming, to put the helm up and let the sea take the boat astern; if it was allowed to take her on the quarter, there would be a risk of its causing the boat to broach-to, and thereby bring the wind and sea abeam, which is the worst position for it.

Never jam the helm suddenly over, but always put it over gradually.

If caught in a squall with the wind abeam or before it, luff, and ease off the foresheet; but if there is much in it, shorten sail at once, by either lowering the foresail, or letting go the throat and peak halliards if in a launch or pinnace.

In taking in a lugsail haul down the luff and ease away the sheet, to spill the wind out of the sail.

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A boat will not carry as much sail on a wind as she will off it; therefore, before rounding to, consider the advisability of reefing beforehand.

If sailing on a wind and there is any doubt of weathering any danger, go about and do not try to weather it by jamming the boat up in the wind, with the probable result that she loses her way, becomes unmanageable, and the danger is fouled.

If a boat capsizes and remains afloat, the crew should remain by her and hold on to her or to some of the wreckage until assistance arrives. As long as there is any chance of assistance it is preferable to remain by the boat rather than strike out for the shore, which always appears closer than it is, and which, through surf or currents, might be difficult to reach.

STEAM BOATS.

Gear contained in a Steamboat.

Hose and funnel for watering.
Coal hammer and fire-irons.
Spanners.
Steaming lights.
Anchor and cable.
Two painters and one sternfast.
Awning and awning stanchions.
Boat's slings.
Backboard.
Fenders.
Boat-hooks.
Ensign and pendant with respective staffs and trucks.
Signal book in cover.
Boat's bag (containing same as for pulling boats)
Water barricoes and bailer.
A pair of oars.
Compass.
Spare wheel ropes.
Bow light screens and stands.

Management of Steamboats.

As the theory of the various factors influencing the steering of a steamboat is dealt with in Volume II. of the Seamanship Manual, we shall consider here only the practical results under the following different conditions :—

(1) Boat and screw going ahead.
(2) Boat and screw going astern.
(3) Boat going ahead, screw going astern.
(4) Boat going astern, screw going ahead.

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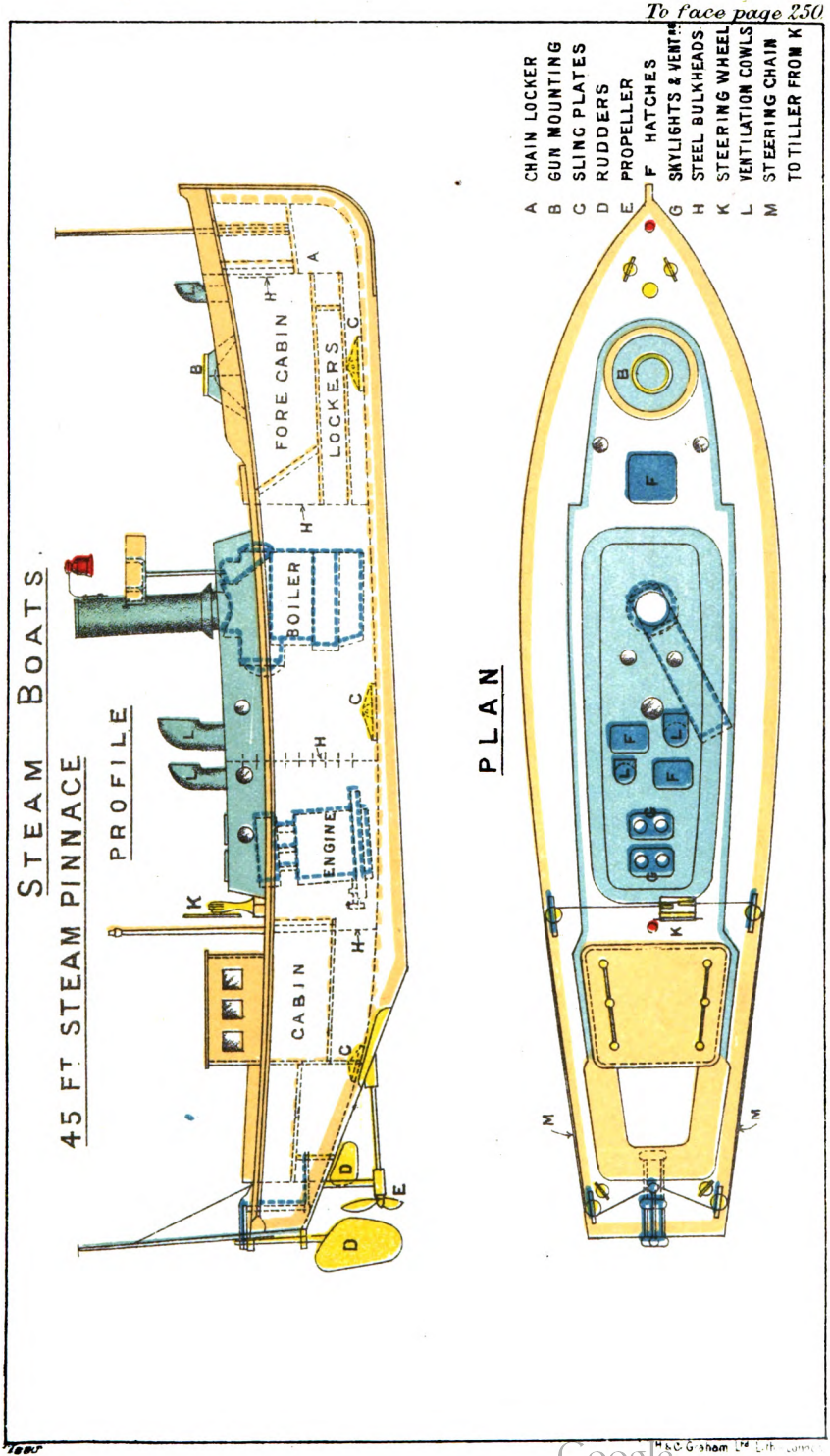

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(1) *Boat and Screw going Ahead.*—The first effect of putting the helm over is to throw the boat off to leeward, that is to say, to the side opposite that towards which it is desired to gain ground. The stern goes off most, but the whole boat, except the bow, is thrown more or less to this side. She ranges ahead along the line of her original course, but slightly to leeward of it, for about two or three boats' lengths before she really commences to gain ground in the desired direction, and though the boat's head has changed some three points, the stern does not finally clear the original course for about two or three boats' lengths measured along that line.

If this manœuvre were resorted to to avoid a danger suddenly discovered dead ahead, and only two or three boats' lengths off, it would probably be ineffectual.

The speed at which the boat is travelling when her helm is put over does not greatly affect the space in which she will turn. As regards the *time* of turning there is, of course, a difference in favour of high speed. If attempting, therefore, to clear a stationary object, it makes very little difference with regard to her success whether she slows or continues at full speed, though it would make considerable difference in the force with which she strikes, if strike she must. If the object to be avoided is another steamboat, there will be an advantage in gaining time by easing down, which will give an opportunity for both boats to recognise the situation clearly, and to act accordingly.

(2) *Boat and Screw going Astern.*—This case is more complicated, for the reason that the effect of the screw is as important as that of the rudder. (This is treated with fully in Volume II.)

If starting astern from rest, the stern will generally go to port, even with hard-a-port helm.

If the boat gathers way astern, and the helm is put to port, there will be a tendency for the stern to go to starboard; if on the other hand the helm is put to starboard, the stern will be thrown rapidly to port.

(3) *Boat going Ahead, Screw Astern.*—This is in some respects the most important case, for the reason that it is the one most frequently connected with danger suddenly discovered close at hand.

There is a widespread ignorance of the rules which govern the steering when the engines are suddenly reversed, while the boat is going ahead. It is assumed, naturally enough, by those who have not studied the

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question, that so long as the boat has headway, she will continue to obey her helm in the usual way, even though the screw is going astern and gradually reducing the speed.

This, however, is not the case, as certain new forces are brought into operation on the rudder and the after-body of the boat, from the instant that the engines are reversed.

The following rules will be found to hold for right-handed screw boats, of average characteristics, when the engines are suddenly reversed from full speed ahead to full speed astern :—

(*a*) The helm kept amidships :—

The head will fall off to starboard and the boat will gain ground to the right before losing her way.

(*b*) The helm put hard-a-starboard at the same time as engines are reversed :—

The head will usually go to port at first but not very rapidly nor very far ; it will then begin to swing to starboard and will fall off more or less on that side.

(*c*) The helm put hard-a-port at the same time as engines are reversed :—

The head will go to starboard and may in some cases persist in swinging to that side. In a majority of cases after swinging somewhat to starboard it will stop and swing slowly back to port, and the boat will come to rest with her head a point or two to port of her original course.

The slower the boat is going ahead and the faster the screw is going astern, the more likely may she be expected to act as above described.

(4) *Boat going Astern, Screw going Ahead.*—This case closely resembles the preceding one, and is subject to the same general law, viz., the boat obeys her helm with reference to the motion of the screw, and not the motion of the boat.

(*a*) The helm amidships :—

As this depends on two forces which are acting in opposition to one another, it is not possible to foresee in any given case which will prevail, and the boat may pay off in either direction. With a right-handed screw the stern should move to port.

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(*b*) If the helm is put to port :—

It will be found that the stern goes decidedly off to port.

(*c*) If the helm is put to starboard :—

The stern will commonly go to starboard.

NOTE.—The whole of the circumstances considered apply to smooth water. Many of the effects being slight they may be modified by the presence of waves.

To Turn in a Limited Space.

It is difficult to turn a right-handed screw boat to port when going astern is necessary in a limited space ; under these conditions, therefore, the turn should if possible be made to starboard.

The boat being at rest proceed as follows :—

First put the helm to port and go ahead ; the stern will immediately swing off to port and will move more rapidly as she gathers way. Allow her to forge ahead as far as space admits, then reverse the engines and shift the helm at the same time to hard-a-starboard ; this will keep the stern swinging to port. Let the boat gather as much sternway as space admits, then go ahead and shift the helm to hard-a-port ; it is at this point that the most pronounced turning effect will take place. Continue to repeat the operation if necessary.

If more convenient to go astern first, commence by going astern with the helm hard-a-starboard ; if there is a breeze on the *starboard* side, avoid going astern too far, as she will back into the wind in spite of all that can be done. If the breeze is on the *port* side, there will be an advantage in going astern as far and as fast as surrounding dangers will permit.

If the space is sufficient to admit of going ahead and astern for some distance and at fair speed, it will not be difficult to turn to port, but the turn to starboard will always be more easily and rapidly made.

Notes.

Use of Helm.—In ships and boats in H.M. Service the turning effect of the rudder increases with the angle of helm, reaching its maximum value at about 35°. When sailing always use the smallest possible helm ; and when going about, &c., never use more than 35°, because beyond that angle the turning effect begins to decrease and the

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rudder resistance to increase rapidly with the helm used; this resistance checks the way of the boat, so causing a tendency to miss stays.

This maximum helm angle applies equally to pulling and steam boats, whether going ahead or astern.

In steamboats which have very high speeds and extraordinary turning power, when going full speed if the helm is put hard over they will turn very sharply, but may drive along their original line even after they have turned their broadsides full towards it. Care should be taken in these boats, *especially when laden with men or gear, not to put the helm suddenly hard over at a high speed owing to the outward heel that will take place,* as when the helm is again righted the tendency to the outward heel will be further increased and if it should happen that she is at the same time rolled outwards by an impulse from a wave, she may be unable to recover, and capsize.

Boats with weights at their ends are more difficult to manœuvre than if the weights were concentrated amidships.

It is important that officers and coxswains of steamboats should be familiar with the manœuvring peculiarities of the boats they are called upon to handle, and every effort should be made to become acquainted with these peculiarities from the commencement of taking charge.

In going alongside a ship or landing-place it is a common mistake to keep too much way on the boat and to rely upon going full speed astern to stop the boat at the proper point. This is bad seamanship. The engines may, and often do, fail to act promptly, and when they do the sudden going astern throws an undue strain upon the engines and upon the rudder fastenings; moreover, the going astern throws the stern off to one side or the other according as the screw is right or left handed.

In coming alongside a ship's gangway in a tideway care must be taken not to catch the tide on the off bow, as this will sweep the bow in before the ladder platform, and perhaps underneath it, with the result that it may capsize or swamp the boat. The boat should come up a little off the gangway, when, by the aid of a boat-rope from the ship, she can then be sheered in by the helm.

A boat may lie alongside safely in a strong tide with a boat-rope made fast to the inner bow and the helm slightly over towards the ship.

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In towing, the stern should be kept well down by shifting weights aft, so as to keep the screw well immersed and give a good hold on the water.

When running in a sea way, speed should be somewhat reduced, not only to avoid shipping seas but to reduce the strain on the machinery due to the "racing" of the screw. In running into a sea it is possible by careful handling to make fair speed, watching the seas, and easing or even stopping for a moment as heavy ones are seen bearing down on the boat. If running more or less across the sea, it is well to head up momentarily for a heavy wave.

Fitting of Steamboat for towing Heavy Lighters.

The picket boats engaged in towing heavy lighters at the salvage of H.M.S. "Montagu" off Lundy Island were fitted in the following manner:—

(1) A length of 6-inch hemp rope (the largest available) was secured round the boat just below the rubbing strake, and on this at intervals of about 10 feet large puddings of oakum, canvas, &c., were formed, and specially large ones round the stern and under each quarter badge. These puddings projected out well beyond the rubbing strake and saved the boats considerably when going alongside ships or lighters in the rough sea.

(2) A 2½-inch wire strop was fitted, the bight taken round the conning tower forward, and the parts seized together just abaft it and taken aft between the funnels through the scuttle in fore side of cabin and right aft through the cabin into the stern sheets, where a hook was seized in the bight.

(3) The after part of the cabin was built up with two strong upright baulks (the doors being removed) and a horizontal baulk secured across them and cut as a horse.

(4) An iron horse was bolted down to the deck right aft in the stern to carry the tow-rope clear of cleats, fairleads, &c.

(5) The tow-rope used was a 5-inch Manilla, which owing to the "give" or "spring" in it proved to be far more satisfactory than either hemp, chain, or wire.

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(6) The best length of tow can only be decided by experience, as it would appear to depend on—

(*a*) the description of sea running;

(*b*) the weight of the lighter;

(*c*) the speed.

Under certain circumstances it is quite possible to have too long a tow.

(7) Picket boats engaged in towing had their anchors stocked on forecastle, and chain grapnel bent on ready for letting go at a moment's notice.

On one occasion this saved a boat which had been thrown back on the tow-rope by the sea and fouled her screw. If she had not been able to let go her anchor at once, she would have been dashed to pieces on the rocks. The lighter on this occasion was being towed by two boats; the second boat was able to hold the lighter, so that, after anchoring, the disabled boat was able to have her hawser cut by the men in the lighter and rode at the full scope of her cable within a few yards of the rocks until assistance could be sent to her.

Raising of Picket Boat sunk in Seventeen Fathoms.

On March 28th, 1908, the picket boats of "Illustrious" and "Venerable" collided when steaming at full speed; both boats got alongside "Illustrious," but the "Venerable's" boat, which had been struck just abaft the funnels, making a hole 3 feet by 18 inches, sank alongside in 17 fathoms.

Divers were sent down, and the end of a 4½-inch wire hawser shackled to the after sling bolt in the boat, the hawser being rove from the after capstan on the quarter-deck through a block on after upper deck casemate, through a block at heel of main derrick, and through a block at derrick head. The boat was hove up by this hawser until the stern was 10 feet out of the water, and allowed to drain, and then gradually lifted until about two-thirds of the boat was out of the water.

A 3½-inch wire bale sling strop was now passed round the boat by the two cutters, one cutter being alongside the ship before the picket boat and the other veered astern of it from a grass hawser on the lower boom, the sling being in the latter boat with a heaving line bent to one end of it which was passed along the net shelf into the

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other cutter, the sternmost cutter being hauled ahead; both cutters were brought together ahead of the picket boat, and one eye of the sling passed through the other allowing the strop to slip down until it was below the damaged part; the centre leg of picket boat's slings was hooked to the eye of the sling and the main derrick purchase to the ring.

The derrick purchase was hove up so as to equalise the strain with the 4½-inch wire until the damaged portion was above water.

The hole being repaired from a cutter the boat was lifted as high as possible and allowed to drain.

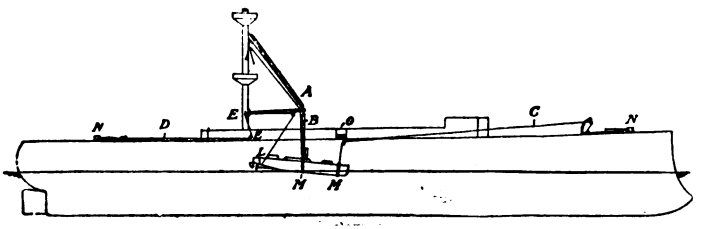
Another 3½-inch wire sling as a foremost strop was now passed under the fore part of the boat by the two cutters in a similar manner to the centre one and the end of a 3½-inch wire hawser shackled to it, the sling being placed just forward of the boat's conning tower.

The 3½-inch wire hawser was rove from the foremost capstan through the leading block at the foot of the port cat davit, through the cat block on starboard cat davit, through a leading block secured to baggage port, and hence to foremost sling round the boat.

The main derrick was hauled forward until the lead of the foremost hawser plumbed the foremost sling; the 3½-inch hawser was then hove taut and the boat placed on an even keel by easing the after hawser and derrick purchase.

The picket boat was now emptied of water by the fire-engines worked from the cutters.

Fig. 1.



A—Main derrick topping lift.
B—Main derrick purchase.
C—3½-inch wire hawser.
D—4½-inch wire hawser.
E—Spare stern anchor iron leaning blocks.
L—End of 4½-inch wire shackled to stern sling bolt.
M—3½-inch wire bale sling strops.
N—Capstans.
O—Baggage port.

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Fig. II.

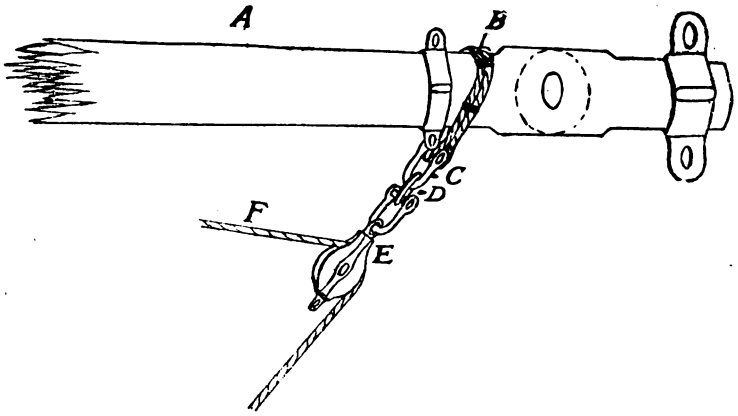

Fig. II. shows the arrangement at main derrick head for block ot after slings.

A—Main derrick.
B—5½-inch wire bollard strop.
C—Towing shackle.
D—Ring of steam pinnace's slings (legs stopped up under derrick).
E—Spare stern anchor block and shackle.
F—4½-inch wire hawser.

Fig. III.

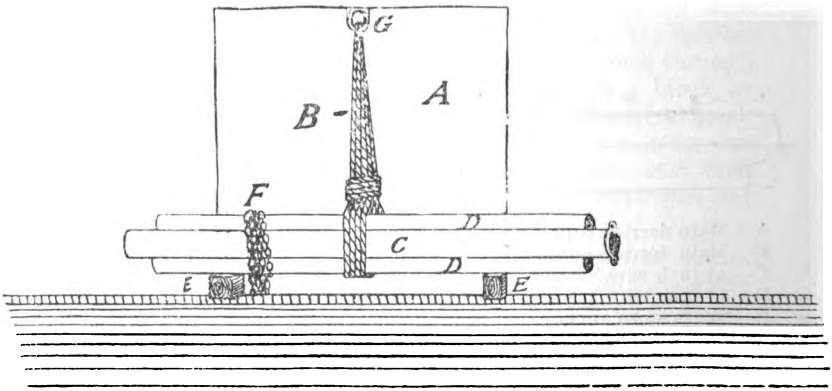

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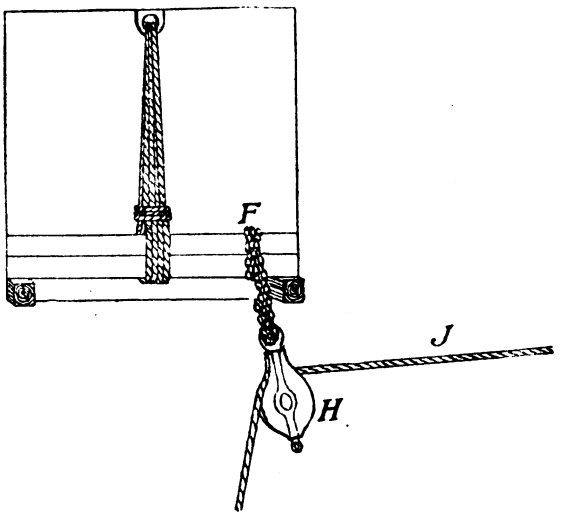
Fig. IV.



Figs. III. and IV. show method of securing leading block for foremost 3½-inch wire hawser at baggage port.

A—Baggage port.
B—Lashing.
C—Mining derrick.
D—6-inch wooden spars.
E—Wooden chocks.
F—Chain lashing.
J—3½-inch wire hawser.
H—Spare cat block.

Fig. V.

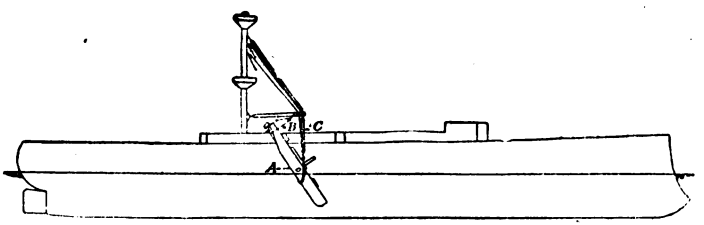


Fig. V. shows boat hoisted by 6½-inch wire hawser and main derrick purchase, for repair of hole.

A—Hole.
B—4½-inch wire hawser.
C—Derrick purchase.

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Fig. VI.

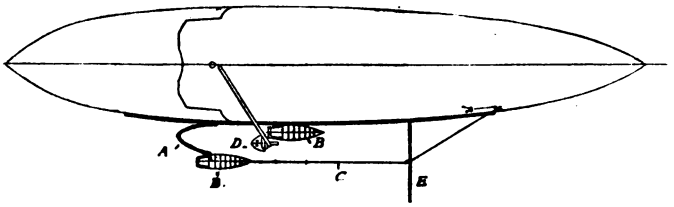

Fig. VI. shows method of placing bale sling strop under the picket boat.

A—3½-inch wire bale sling strop.
B—Cutters.
C—Grass hawser.
D—Picket boat.
E—Lower boom.

Fig. VII.

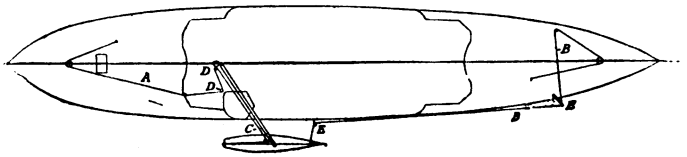

Fig. VII. shows the leads of the wires.

A—4½-inch wire hawser.
B—3½-inch wire hawser.
C—Derrick purchase.
D—Stern anchor blocks.
E—Cat blocks.

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TABLE OF BOATS' WEIGHTS, &c.

Boat.	Length.	Weight.	Sail Area.	Length of Grapnel.	Size of Grapnel.	Weight of Anchor.	Life-Saving Capacity.*	Length of Mast.	Diameter of Mast.	Length of Gaff.	Diameter of Gaff.	Remarks.
	Feet.	tons cwt.	Sq. ft.	fathoms.	Chain.	Lbs.		Ft. Ins.	Ins.	Ft. Ins.	Ins.	
Steam pinnace	56	18 0	—	40	$\frac{3}{8}$″	120	80	—	—	—	—	The weights of the steamboats are inclusive of water in tanks and in boiler to working height, half coal and provisions, but no armament or men.
,, –	45	12 0	—	40	$\frac{3}{8}$″	120	60	—	—	—	—	
,, –	40	12 8	—	40	$\frac{3}{8}$″	100	50	—	—	—	—	
Steam cutter	32	5 15	—	40	$\frac{5}{16}$″	50	40	—	—	—	—	
,, –	23	3 0	—	25	$\frac{1}{4}$″	30	21	—	—	—	—	
Steam barge –	40	10 11	—	40	$\frac{3}{8}$″	100	50	—	—	—	—	
,, –	32	5 3	—	40	$\frac{5}{16}$″	50	40	—	—	—	—	
Launch –	42	7 17	754	40	$\frac{3}{8}$″	120	140	36 7	7	19 0	$4\frac{1}{2}$	The weights of the pulling boats are exclusive of countermining gear, gear for laying out anchors, men and armament, but includes all other gear.
Pinnace –	36	5 0	566	40	$\frac{3}{8}$″	90	86	32 0	6	17 6	$3\frac{1}{2}$	
,, –	32	4 12	418	40	$\frac{5}{16}$″	70	70	28 0	6	15 .9	$3\frac{1}{2}$	
,, –	30	3 13	368	40	$\frac{5}{16}$″	60	62	26 11	$5\frac{3}{4}$	14 6	$3\frac{1}{4}$	

* The numbers given in this column as the Life Saving Capacity of boats are taken from the Establishment of Carpenter's Naval Stores and must never be exceeded. They do not represent the sea capabilities of the boats under all conditions, and the numbers to be carried in boats must be reduced according to the judgment of the Officer present, with due regard to weather conditions, the character of the duty to be performed, and the experience of the persons in charge of the boats.

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Table of Boats' Weights, &c.—*continued.*

Boat.	Length.	Weight.	Sail Area.	Length of Grapnel.	Size of Grapnel.	Weight of Anchor.	Life-Saving Capacity.*	Masts.				Yards.			
								Main.		Fore.		Main.		Fore.	
								Length.	Diameter.	Length.	Diameter.	Length.	Diameter.	Length.	Diameter.
	Feet.	tons cwt.	Sq. ft.	fathoms	Hemp.	Lbs.		Ft. Ins.	Ins.	Ft. Ins.	Ins.	Ft. Ins.	Ins.	Ft. Ins.	Ins
Cutter – –	34	2 3	449	30	3½″	40	66	20 10	4½	23 2	4¾	12 4	3	14 3	3¼
,, – –	32	2 0	382	30	3½″	40	59	20 2	4¾	22 0	4¾	11 6	3	13 6	3
,, – –	30	1 18	357	30	3½″	40	49	19 6	4½	21 0	4¾	11 0	3	13 0	3
,, – –	28	1 13	324	30	3½″	40	40	19 3	4½	20 3	4¾	10 3	3	12 9	3
,, – –	26	1 8	321	30	3½″	40	36	†14 6	†3½	22 0	4½	‡10 9	‡2½	12 2	3
Galley – –	32	0 17	251	25	3″	30	28	13 6	3½	12 4	3½	19 6	2½	15 9	2½
Gig – –	30	0 16	224	25	3″	30	26	12 10	3½	11 7	3½	19 0	2½	15 6	2⅜
,, – –	28	0 15	189	25	3″	30	25	12 4	3½	11 4	3½	17 6	2½	13 10	2¼
Whaler –	27	0 14	168	25	3″	30	24	12 4	3½	11 4	3½	17 0	2½	13 9	2¼
Montaguwhaler	27	0 15	189	25	3″	30	27	16 3	3⅝	†12 3	†2½	15 0	2½	‡7 2	‡2
Dinghy –	13½	0 6	71	20	2½″	20	9	—	—	—	—	—	—	—	—
												Sprit.			
Skiff-Dinghy	16	0 5·5	75	20	2½″	20	10	12 0	2½	—	—	11 6	1⅝	—	—
Punt – –	13½	0 8	—	20	2½″	20	8	—	—	—	—	—	—	—	—
,, – –	10	0 5	—	—	—	—	6	—	—	—	—	—	—	—	—
Whaler for T.B.D.'s.	25	0 12	—	—	—	—	20	—	—	—	—	—	—	—	—
Dinghy for T.B.D.'s.	13½	0 5	—	—	—	—	9	—	—	—	—	—	—	—	—
Berthon collapsible for T.B.D.'s.	20	0 10.5	—	—	—	—	16	—	—	—	—	—	—	—	—
Dinghy for 1st class T.B.'s.	10	0 4	—	—	—	—	6	—	—	—	—	—	—	—	—

* The numbers given in this column as the Life Saving Capacity of boats are taken from the Establishment of Carpenter's Naval Stores and must never be exceeded. They do not represent the sea capabilities of the boats under all conditions, and the numbers to be carried in boats must be reduced according to the judgment of the Officer present, with due regard to weather conditions, the character of the duty to be performed, and the experience of the persons in charge of the boats.

† Mizen ‡ Mizen Boom.

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General Boat Racing Rules.

Pulling Races.

1. All boats competing carry the distinguishing colour allotted to their ships.

2. No part of the hull of a boat, nor any of her crew, is to touch the rounding mark or ship.

3. No boat is to touch another boat, nor are her oars to touch those of another boat in taking the water of her.

4. Any boat that wilfully or from neglect fouls another boat is disqualified.

5. If a boat alters her course in order to prevent a boat coming up astern from passing her, she does so at her risk and will be disqualified if fouled.

6. Any outside boat not giving way to an inside boat in rounding a mark, provided that an overlap has been established before the leading boat alters her helm for the purpose of rounding, will be disqualified. (It is considered to be an overlap if any portion of the hull be overlapping when the two boats are proceeding on nearly parallel courses.)

7. All objections should be lodged on board the flagship within an hour of the boats' arrival on board.

8. Two boats of a class should start, or no prize.

9. Boats pulled under service conditions with the service number and description of oars, the crew sitting on their proper thwarts.

10. No extra fittings allowed in boats except a long tiller and any stretchers that do not interfere with the structure of the boats.

11. Boats to be pulled with the shells, thwarts, seats and keelson boards intact; any other movable gear, as well as gun-mountings, badges, and fore and aft sailing thwarts, may be taken out.

12. Bilge keels, or hand grips, not to be removed.

13. Boats not to be blackleaded, nor should they have false stems or raised thwarts.

14. Boats should not be out of the water more than a week before the race.

15. None of the crews should be excused from the ordinary duties of the ship except on the day of the race. They should not form a separate mess by themselves for boat-racing purposes.

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16. The following are exceptions to Rule 9 :—

(*a*) In "All Comers" race, extra thwarts, stools, and any description of oars are allowed, but no outrigger nor any fittings projecting outside the boat.

(*b*) Eight-oared double-banked boats may pull ten oars, putting in necessary fittings.

(*c*) Seven-oared galleys may pull six oars in six-oared races.

(*d*) Any description of oars may be used in officers' races.

(*e*) In launches' races hammocks may be used to sit on.

(*f*) Service fir oars may be used in single-banked boats.

17. Borrowing boats from other ships is not permitted except in officers' and cup races ; in the latter case only when the ship cannot take part in the race owing to not having the particular class of boat required.

18. Ships smaller than Captain's commands pair together.

19. In cup races boats are steered by a Chief or Petty Officer, Colour-Sergeant, Sergeant, or paid Lance-Sergeant, and in boys' races by a boy. In other races the coxswain may be of any rank or rating. Officers only act as coxswains in officers' races ; but optional for them to go in double-banked boats so long as they do not steer.

20. E.R.A.'s cannot pull with C.P.O.'s.

21. In officers' skiff races, skiffs pulling four oars should have a coxswain.

22. In races where different classes of gigs or foreign-built boats pull together, the handicap by length of boat is as follows :—

Double-banked boats	– 4 seconds per mile per foot.
Six-oared gigs –	– 5 ,, ,, ,, ,, ,,
Whalers and five-oared gigs – – –	– 9 ,, ,, ,, ,, ,,

In six-oared gig races 28-foot boats may compete with 30-foot boats, but receive no time allowance, 32-foot boats only being handicapped.

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Sailing Rules.

1. Every boat when full of water must have sufficient buoyancy to support her crew in the water, the maximum number of barricoes or casks that have been used as ballast during the race being full.

N.B.—This does not apply to launches and pinnaces which have a negative buoyancy.

2. Boats to carry a number of persons at least equal to their full crew, except in the case of boom boats which are allowed to sail with half crews, and their own anchor and cable.

3. No ballast to be hung outside the boat.

4. Flying start. All boats must have ordinary sail set two minutes before the start, no oars out, and showing their distinguishing marks and flag.

5. A gun is fired and the "Preparative" hoisted 15 minutes before Class 1 starts. The numeral flag of the class is hoisted two minutes before each class starts, and a gun fired and flag hauled down when each class is to start. If a boat is across the line before the starting gun is fired and the signal of her class hauled down, her distinguishing signal is shown until she recrosses the line.

6. All boats in the proximity of any boat that capsizes, or of any man or men fallen overboard, are to render immediate assistance. Boats rendering such assistance shall have the option of sailing the two leading boats, provided the committee are of opinion that they stood a chance of taking a prize. In this case the relative positions of the two leading boats with respect to each other in the first race will be adhered to.

7. No boat is to touch another in passing.

8. No part of the hull of a boat, nor any of her crew, is to touch the rounding mark or ship.

9. No boat is to touch another boat in taking her water.

10. Ballast may be started and taken in again.

11. The following are disqualifications :—

(*a*) A boat using any propelling power other than sail ; no rolling allowed.

(*b*) Any boat refusing to go about or to bear up on being hailed by another which is standing into danger which she cannot otherwise avoid. The other boat is to go about at the same time.

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(*c*) Any boat not obeying the rules of the road.

(*d*) Any boat that wilfully or by neglect fouls another boat.

(*e*) Any outside boat not giving away to an inside boat in rounding a mark, provided that an overlap has been established before the leading boat alters her helm for the purpose of rounding. (It is considered to be an overlap if any portion of the hull or spars be overlapping when the two boats are proceeding on nearly parallel courses.)

(*f*) Any boat bearing away or altering course to leeward except to avoid danger, thereby compelling another boat to alter her course.

(*g*) Any boat going about when a boat is passing to windward of her, although the former may luff to prevent being passed.

12. All objections to be lodged by letter within an hour of the boat's arrival on board her ship.

13. The first four boats are to go alongside the flagship immediately after the race to be inspected, if required. The winning boat may be tested for buoyancy before the prize is awarded.

Special Rules for Service Rigs.

1. Service rig is the rig the boat uses on service made of service canvas by service labour. The total sail area is to be the standard sail area. Any boat which is not considered a *bona fide* service rig may be disqualified. No topsails are allowed in launches and pinnaces. Awnings may be used, but no extra spars to spread them. No false keels allowed. Single-banked boats may carry spreaders for use with clew of sail.

2. No extra fittings are to be provided.

3. Boats are to carry all their service gear; only service washboards may be used. Awnings and stanchions need not be taken unless desired.

4. An excess of sail area will be allowed up to 10 per cent. of the whole under the following penalties:—

Up to 1 per cent. – 1 minute;
Up to 2 per cent. – 2 minutes;
Up to 3 per cent. – 3 minutes;

and so on.

Over 10 per cent. – Boat disqualified.

5. The course should be triangular and, if possible, 4½ miles in length. Twice round.

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Special Rules for Private Rigs.

1. No restrictions as to sails, number of crew, or keels, except that they must be fixed for the whole of the race, but the general sailing rules must be adhered to as far as they apply, except that anchors and cables need not be taken.

2. The course to be triangular, if possible, about 4 miles in length and three times round, or 6 miles and twice round.

Handicaps and Classes for Service Rigs.

COURSE.—9 Miles.

Start.	Class.	Boat.	Minutes.
0 minutes –	I.	25 ft. Whalers, old patt. – – –	0
		25 ft. Gig ,, – – –	
		27 ft. Whaler ,, – – –	7
		28 ft. Gig ,, – – –	28
		26 ft. Cutter – – – – –	
		25 ft. Montagu Whaler – – –	
		30 ft. Cutter – – – – –	37
4 minutes –	II.	30 ft. Gig, old patt.– – – –	41
		27 ft. Montagu Whaler – – –	
		32 ft. Cutter – – – – –	
8 minutes –	III.	32 ft. Gig, old patt. – – –	43
		30 ft. Gigs. Montagu – – –	
		32 ft. (without keels) – – –	
		34 ft. Cutter – – – – –	45
15 minutes –	IV.	32 ft. de Horsey Cutter (with keel) –	50
		34 ft. de Horsey Cutter (with keel) –	52
		36 ft. Pinnace – – – –	52
24 minutes –	V.	42 ft. Launch– – – – –	61
27 minutes –	VI.	30 ft. Special Gig – – – –	61
		32 ft. Special Gig – – – –	64

No allowance is made for Sail area.

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CHAPTER VII.

RULE OF THE ROAD AT SEA.

AIDS TO MEMORY IN FOUR VERSES.

BY THOMAS GRAY.

I.—*Two Steamships Meeting.*

When both Lights you see ahead,
Port your Helm and show your Red.

II.—*Two Steamships Passing.*

Green to Green—or Red to Red—
Perfect Safety—go ahead.

III.—*Two Steamships Crossing.*

NOTE.—This is the position of greatest danger—there is nothing for it but a good look-out, caution and judgment.

If to your Starboard Red appear
It is your duty to keep clear;
To act as judgment says is proper
To Port—or Starboard—Back—or stop her.

But when upon your Port is seen
A Steamer's Starboard Light of Green,
There's not so much for you to do,
For Green to Port keeps clear of you.

IV.—*All Ships must keep a look-out and Steamships must Stop and go Astern if necessary.*

Both in safety and in doubt
Always keep a good look-out;
In danger with no room to turn,
Ease her—Stop her—go Astern.

V.—*Every Vessel overtaking any other shall keep out of the way of the overtaken Vessel.*

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Special Lights carried on occasions by H.M. Ships.

In Harbour the following Lights will be carried by Flagships, in addition to the Stay Lights :—

An Admiral—3 Stern Lights and 1 Top Light.

A Vice-Admiral—2 Stern Lights and 1 Top Light.

A Rear-Admiral or Commodore—1 Stern Light and 1 Top Light.

An Admiral's stern lights are carried on the after side of the after bridge or shelter deck, one at each end and one at the middle. The three are level.

* A Top Light is carried in the after part of the Main Top, and shows a White Light over an arc of the horizon of 16 points of the compass, that is from right astern to the beam on each side.

NOTE.—*See* Signal Chapter on " Lights."

Sound Signals for Fog, &c.

Steam Whistle or Siren.

One prolonged blast at intervals of not more than 2 minutes.

Two prolonged blasts at intervals of not more than 2 minutes, with an interval of about 1 second duration between them.

Three blasts, one prolonged, followed by two short blasts at intervals of not more than 2 minutes.

Steam vessel having way upon her.

Steam vessel under way, but stopped and having no way upon her.

Vessel when towing—Vessels employed laying down or picking up telegraph cable—Vessel not under command—Vessel towed (optional).

Fog Horn.

One blast, at intervals of not more than 1 minute.

Two blasts in succession, at intervals of not more than 1 minute.

Three blasts in succession, at intervals of not more than 1 minute.

Sailing vessel under way on Starboard tack.

Sailing vessel under way on Port tack.

Sailing vessel under way with wind abaft the beam.

Bell.

A *Bell* rung rapidly for about 5 seconds, at intervals of not more than 1 minute.

Vessel at anchor.

* At sea Top lights only are carried by all Admirals.

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Steering and Sailing Rules.

Two Sailing Ships Meeting.

(*a*) A vessel which is running free shall keep out of the way of a vessel which is close hauled.

(*b*) A vessel which is close hauled on the Port tack shall keep out of the way of a vessel close hauled on the Starboard tack.

(*c*) When both are running free, with the wind on different sides, the vessel which has the wind on the Port side shall keep out of the way of the other.

(*d*) When both are running free with the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward.

(*e*) A vessel which has the wind aft shall keep out of the way of the other vessel.

Ships towing.

Ships towing obey the ordinary rule of the Road for other steam vessels, except in a fog, when by reason of the fog signal being the same as that for vessels not under control, all vessels should keep clear of them.

Two Steam Vessels Meeting.

(*a*) When two steam vessels are meeting end-on, or nearly end-on, so as to involve risk of collision, each shall alter her course to Starboard, so that each may pass on the Port side of the other.

(*b*) When two steam vessels are crossing so as to involve risk of collision, the vessel which has the other on her own Starboard side shall keep out of the way of the other.

(*c*) When a steam vessel and a sailing vessel are proceeding in such direction as to involve risk of collision, the steam vessel shall keep out of the way of the sailing vessel.

(*d*) In narrow channels every steam vessel shall, when it is safe and practicable, keep to that side of the fairway or mid-channel which lies on her Starboard side.

Nothing in these rules shall interfere with the operation of a special rule, duly made by local authority, relative to the navigation of any harbour, river, or inland waters.

NOTE.—These rules apply equally to sailing boats and steamboats.

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For International Regulations for Preventing Collisions at Sea, *see* Volume II.

Steamboats should give way to boats under sail and to boats under oars, except in the case of where one boat is overtaking the other, when the overtaking boat should give way.

Boats under oars should give way to boats under sail, except in the case where one boat is overtaking the other, when the overtaking boat should give way.

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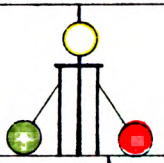
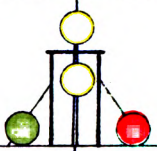
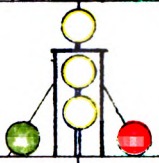
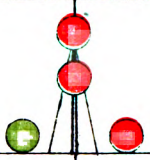
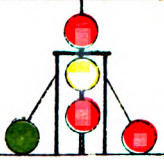
	**A Steam Vessel under way,** showing Masthead, Port, and Starboard Side Lights. (Masthead visible 5 miles, Side Lights 2 miles); or **Steam Fishing Vessel, shooting or towing lines.**
	A Steam Vessel under way, showing the additional Masthead Light aft, also the usual Masthead, Port, and Starboard Side Lights. (Masthead visible 5 miles, Side Lights 2 miles).
	**A Steam Vessel towing another vessel,** showing 2 Masthead Lights, vertical, also the Port and Starboard Side Lights. (Visible 2 miles).
	**A Steam Vessel towing more than one vessel,** when the length of tow exceeds 600 feet, showing 3 Masthead Lights, also the Port and Starboard Side Lights.
	A Vessel not under command, through accident, not making way through the water, showing 2 Red Lights, vertical, one over the other. (Visible 2 Miles).
	**A Vessel not under command,** but making way through the water, showing 2 Red Masthead Lights, vertical, and usual Side Lights. (Visible 2 Miles).
	A Vessel not under command by day, showing 2 Black Balls or Shapes, vertical, each two feet in diameter.
	**A Vessel employed repairing or laying telegraph cables, making way through the water,** not under command, showing Red-White-Red Lights, vertical, usual Side Lights. (Visible 2 Miles).

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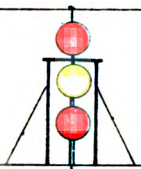
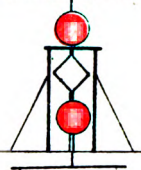
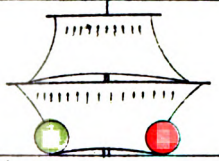


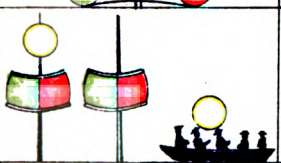
A Vessel employed repairing or laying telegraph cables but not making way through the water, not under command, showing Red-White-Red Lights, vertical. (Visible 2 Miles).



A Vessel employed repairing or laying telegraph cables by day, not under command, showing 2 Red Circular Shapes with White Diamond Shape between them, vertical.

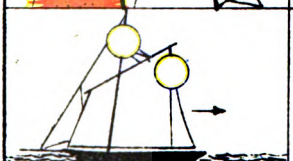


A Sailing Vessel under way, or **any vessel being towed,** showing Red Light on Port Side and Green Light on Starboard Side. (Visible 2 Miles); or **Fishing Vessel, shooting or towing lines.**

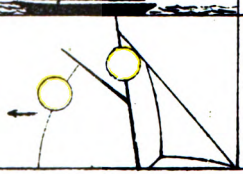


Small Steam Vessels under 40 tons carry a White Light (visible 2 miles) over a combined Red and Green Lantern (visible 1 mile).
Under 20 tons showing combined Red and Green Lantern in time to prevent collision.
Rowing Boats show a White Light occasionally.

A Pilot Vessel on Station, showing a Bright Light at Masthead, visible all round, and a Flare-up Light at short intervals, not over 15 minutes. Usual Side Lights when required.



Open Boat, fishing gear extending not more than 150 feet, shows all-round White Light. When outlaying gear extends more than 150 feet, a second * White Light 3 feet below and 5 feet horizontally from first Light is shown in direction of gear.
Fishing Vessel at anchor, gear down, also shows same Lights—lower in direction of net or gear.



Vessel or Boat fishing with drift net, showing 2 Globular Lights, the lower showing in * direction of net. Vertical distance not less than 6 feet nor more than 15 feet. Horizontal distance not less than 5 feet nor more than 10 feet. (Visible 3 Miles).

* Lights, Fog Bells and Horns on Fishing Vessels are only applicable in North Sea, North of Cape Finisterre.

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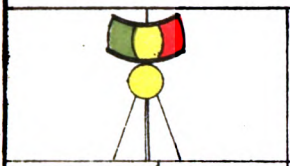
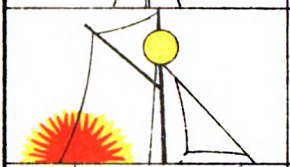
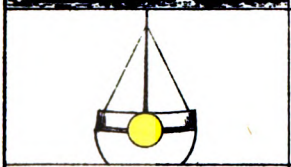


A Steam Trawler under way, showing combined Lantern White Light ahead, Red
* Light on Port, and Green Light on Starboard Sides (the latter now show **2** points abaft the beam in lieu of **4**), below which a White Light shows all round.



A Sailing Trawler under way, showing all-round White Light. White Flare-up
* Light is shown on approach of other vessels in time to prevent collision.

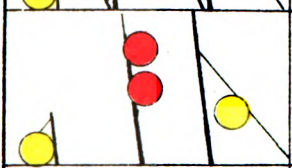
Fishing Vessel showing basket *by day*,
* indicating its occupation to an approaching vessel.
If at anchor they must show this Signal on the same side on which the vessel can pass.



A Vessel being overtaken, or **towing a vessel,** showing a Stern Light (a Flare-up Light may be substituted for this). (Visible 1 Mile).

A Vessel at anchor, under 150 feet in length, or any fishing or open Boat, showing Globular Bright Light forward, or where best seen, visible all round the horizon. (Visible 1 Mile).

A Vessel at anchor, exceeding 150 feet in length, showing **2** Globular Lights visible all round, the lower of which shall be aft. (Visible 1 Mile).



A Vessel aground, in or near a Fairway, showing in addition to the Anchor Light the **2** Red Lights. **2** Anchor Lights when over 150 feet in length.

A Vessel desiring to attract attention, showing Flare-up, or may use a Detonating Signal, in addition to the lights she is required to carry. (Starboard Side).

* Lights, Fog Bells and Horns on Fishing Vessels are only applicable in North Sea, North of Cape Finisterre.

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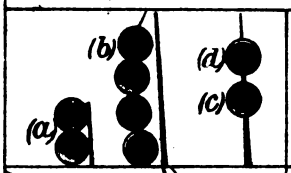
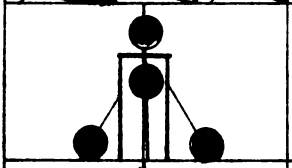
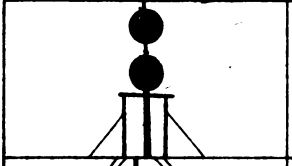


Special Lights for Squadrons, etc.—(*a*) Man-of-war position, used when entering harbour where other ships are present, various uses in fleet at sea, etc. (*b*) Signals used by foreign men-of-war, not necessarily at main. (*c*) Steaming Light. (*bd*) Mercantile Marine recognition signals (various). (*a*) Always at ensign staff.

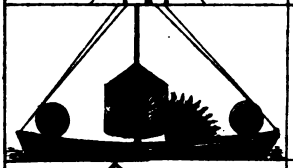
A Steam Vessel under sail only, but having her Funnel up. **By Day,** showing one Black Ball 2 feet in diameter at Fore-Masthead.



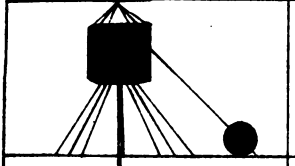
A Steam Pilot Vessel under way, showing Red Globular Light under the usual Masthead Light, also the Side Lights carried by all pilot vessels. (Visible 2 Miles).



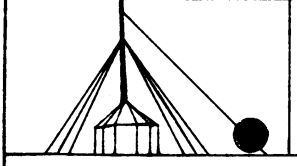
A Steam Pilot Vessel at anchor, showing Red Globular Light under the usual Masthead Light, visible all round, but not the usual Side Lights.



A Lightvessel out of her proper station, showing Red Light at each end of vessel and a Red Flare-up Light every 15 minutes.



A Lightvessel on her station, showing in addition to her Distinguishing Light, a White Light from the Forestay just above the Rail to show in what direction she is riding.



When a Lightvessel is unable to exhibit her usual lights whilst on her station, the riding light only is shown.

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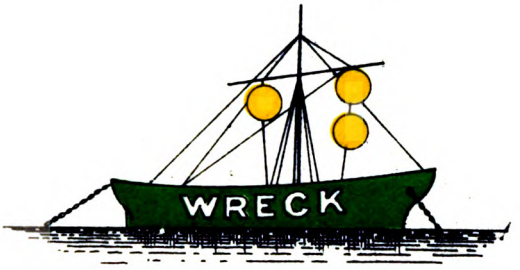

By Day, Wreck-Marking Vessels exhibit **3** Black Balls on a yard, 20 feet above the sea; **2** Balls being placed on the side vessels should pass, and **1** on the other.

By Night, Wreck-Marking Vessels exhibit **3** White Lights in the same manner, as the Day Marks with the same meaning.

During Fog, Gong or Bell sounded every minute.

Wreck-Marking Vessels have Top Sides Coloured Green.

NOTE.—Vessels should pass on the *same* side as the **2** Balls or Lights.

NEW REGULATIONS FOR FOG SIGNALS.

Steam Fishing Vessels make a blast each minute with the whistle.

Sailing Fishing Vessels with the fog horn, each blast to be followed by ringing the bell.

In the Mediterranean and on Coasts of Japan and Korea, sailing fishing vessels of less than 20 tons are not obliged to carry the lower lights. Should they not carry it they shall show in the same position a White Light in the direction of net or gear. (Visible not less than 1 mile).

SOUND-SIGNALS FOR VESSELS IN SIGHT OF ONE ANOTHER.

The words "short blasts" used in this article shall mean a blast of about one second's duration.

When vessels are in sight of one another, a steam-vessel under way, in taking any course authorised or required by these Rules, shall indicate the course by the following signals on her whistle or siren, viz. :—

One short blast to mean, "I am directing my course to starboard."

Two short blasts to mean, "I am directing my course to port."

Three short blasts to mean, "My engines are going full speed astern."

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CHAPTER VIII.

ANCHOR WORK.

Definitions.

A ship is said to be moored when she has two anchors down, or is secured by means of chains or wires alongside a jetty.

Moorings.—Are two or more anchors laid down with large chains, which are brought to a central ring, for a ship to secure to, *see* Vol. II.

Shortening-in Cable.—To heave in a certain portion of it.

Short Stay.—The cable is said to be at short stay when hove close in, but not up and down.

Up and Down.—The cable is said to be up and down just previous to the anchor being aweigh.

Grow.—A cable is said to grow in the direction in which it is lying.

Anchor Aweigh.—The anchor is said to be aweigh as soon as it is broken out of the ground.

Heaving in Sight.—An anchor is said to be heaving in sight as soon as it can be seen when weighing. It is reported as "Clear anchor" when it is hanging fairly by the ring, and "Foul anchor" if the cable is round the anchor.

Clear Hawse.—A ship is said to have a clear hawse when riding with two anchors down and the cables are clear of one another.

Foul Hawse.—A ship is said to have a foul hawse when riding with two anchors down and no swivel on, and the cables have crossed each other; if the ship swings through 180° a cross is formed, through 360° an elbow is formed, through 540° an elbow and a cross are formed, and through 720°, or twice round, a round turn is formed.

Veer Cable.—Is to pay or ease out the cable.

Surge.—Is to veer suddenly. A hawser slipping round the barrel of a capstan is said to surge.

Warping.—Moving a ship by means of hawsers.

Kedging.—Moving a ship by means of small anchors and hawsers.

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To Bitt the Cable.—To take turns round the riding bitts with the cable. Starboard cable right to left. Port cable left to right.

To Bring To.—To attach a cable or a hawser to a capstan or a hawser to a winch.

To come To.—To anchor.

Anchor A'Cock Bill.—When the anchor is eased out of the hawse pipe and hung by the ring.

Stream the Buoy.—To drop the anchor buoy over the side just previous to letting go the anchor.

Bleeding a Buoy.—To bore a hole in the buoy for the purpose of letting out the water which has leaked in.

Foul Berth.—When a ship has not room to swing.

Anchor Dragging.—An anchor is said to be dragging when it is not holding in the ground. It is said to bite well when it has a good hold in the ground.

Anchor coming Home.—When the cable is being hove in, if the anchor is dragged towards the ship instead of the latter being hove up to it, it is said to be coming home.

Drop an Anchor under Foot.—Is to let an anchor go without veering cable after the anchor has reached the bottom. This is sometimes done to steady the ship's head and prevent her yawing when lying to a single anchor in a gale of wind.

A Spring.—Is a hawser led from aft and made fast to the cable, or some near object, so as to turn the ship in a required direction when at anchor; also to secure the ship alongside a jetty or other vessel.

Chain Hook.—A long iron hook with cross handle for moving links of cable.

Hook Rope.—A wire or hemp rope, generally from 10 to 15 fathoms long with an iron hook at the end. Used principally in cable work.

Adrift.—Slipping or breaking away from moorings.

Cat Davit.—An iron davit fitted in older ships with close stowing anchors on each bow to lift the anchor from the waterline to the anchor bed by means of a cat pendant. They are fitted with hinges and bolts near the deck in order that they can be lowered so as not to obstruct the gun-fire. There are no cat davits in ships with vertically stowed anchors, but strong plate and angle structures fitted, each with a large sheave, are built on to the ship's side

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directly over the anchor's stowing positions. The cat pendant is rove through the sheave. This fitting is called a "clump cathead."

A Clump Cathead is fitted at the deck edge on each side in ships with stockless anchors to hang the bower anchor when the hawse pipe is being used by the cable for securing to a buoy. It is fitted with a hinged snatch piece across the jaws to prevent the cat pendant jumping out.

Cat Pendant.—Is a wire pendant fitted with a heart, thimble, and link at each end; it is rove through an upper and lower block on cat davit, and hooked or shackled to the gravity band on the anchor, or to the anchor ring; the other end is taken round the capstan.

Anchor Bed.—Is a sloping ledge on which anchors with stocks are stowed and secured.

All anchors except stockless anchors are secured to the anchor bed by means of securing chains and tumblers. The standing parts of the chains are shackled to eye plates in the anchor bed, and are rove under and over the shank of the anchor, the end links, which are large, placed over the horns of the tumblers; extra short securing chains are also used.

The tumbler is a revolving bar secured on the inboard side of the anchor bed, having three horns, two of which are curved inboard to take the securing chains; the third is for the releasing lever. By raising the latter the horn gearing with it is released and the bar revolves, releasing the securing chains from the horns.

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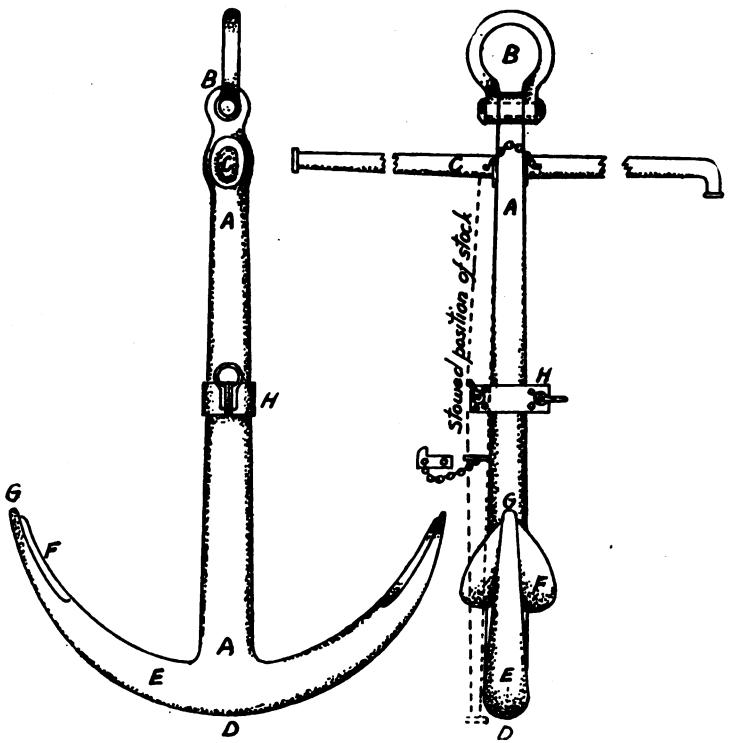
ADMIRALTY PATTERN ANCHOR.



A Shank.
B Ring.
C Stock.
D Crown.
E. Arms.
F Flukes.
G Pea or Bill.
H Gravity Band.

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ANCHORS.

Three types of anchors are in use in H.M. Navy, viz., the Admiralty, the Close-stowing, and the Stockless anchor.

Admiralty Pattern.

This anchor has been in use for many years. It has the arms and shank in one, with the stock standing perpendicularly to the line of the arms. With the stock in place it cannot be stowed flat, but projects above the deck upon which it is lying. When let go the anchor is pulled along the ground with the stock lying flat, and in this position the lower fluke enters the ground and holds the ship. The upper arm will then stand above the shank, and the cable is liable to foul it with the swinging of the ship. It will be seen from the figure that the stock is made with one part straight and the other curved at the end; the straight part has a shoulder, which bears against the shank; the part with the curved end has a rectangular slot through it near the shank, and into this fits a forelock, which, when shipped into the hole, prevents any motion of the stock through the shank. By taking out the forelock the stock can be moved through the shank of the anchor until the ring or bulb at the curved end brings up. This bulb is larger than the hole in the shank, and prevents the stock being unshippped altogether. When stowed, the stock lies along the shank, as shown in the figure.

This pattern anchor is now used only for boats, kedge anchors, and for fixed moorings; when used for the latter, the stock is not shipped, and the arm standing above the ground is bent over until the fluke lies along the shank. Its holding power is generally considered to be superior to the same weight anchor of either of the other types.

The weight of the stock is about one-fifth the weight of the anchor.

Martin's Close Stowing Anchor.

In this anchor the stock and the arms are in one plane when stowed, and there are no parts projecting appreciably above the shank. It was, therefore, introduced into ships fitted with guns which trained across the deck, and in which there was not a great distance between the edge of deck and the line of fire when depressed. The arms in this anchor are not fixed to the shank, but turn about a pin, or

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ball socket, in the crown. Stops are provided to limit the angle which the arms make with the shank. This angle is generally about 40 degrees.

In this type of anchor, when drawn along the ground the arms are tripped by large flat "tripping palms" on either side of the arms, and thus cause the flukes to enter the ground and hold the ship. The various makes of the "close-stowing" anchor differ generally in the arrangement and shape of these tripping arms and in the method of providing for the hinging of the palms about the crown. Martin's type of this anchor is that most generally employed in the Service, but other patterns are the Hall, Inglefield, Brown-Lennox, and Baxter.

This type of anchor is used in the latest ships for the stream anchors, and is also used in the older torpedo boats and destroyers for the bower anchors. As usually fitted, it is stowed on a "billboard," or "anchor bed," which is a flat plate at an angle of about 20° to the horizontal, and fitted with two runners, or skids, of bulb bar on which the anchor rests and slides. A cathead is fitted to lift it into position on the billboard after use. In some ships it is stowed vertically outside the ship with the crown resting on a small built-out platform, the shank, arms, and stock being secured by chains and slips, or hempen lashing to eye plates on the skin plating. (*See* figure facing page 280.)

Stockless Anchors.

This type of anchor is very similar to the close-stowing anchor as regards construction and action, but, as its name implies, it has no stock; this allows of its being drawn up and housed in the hawse-pipe. It is now used for the bower and sheet anchors in all classes of ships, with the exception of torpedo boats.

The Admiralty pattern anchor, when fitted as a bower anchor, required the fitting of a cat davit, and in some cases a fish davit, for stowing it.

The close-stowing anchor required the fitting of an anchor bed, cat davit, ground chain, guide blocks, and other fittings. The operation of catting and stowing the anchor was a lengthy one. With the introduction of the stockless type of anchor these fittings are no longer required, and the operation of stowing the anchor after use is exceedingly simple. The weight and cost of these extra fittings, the space occupied by the anchor beds, and the labour involved in

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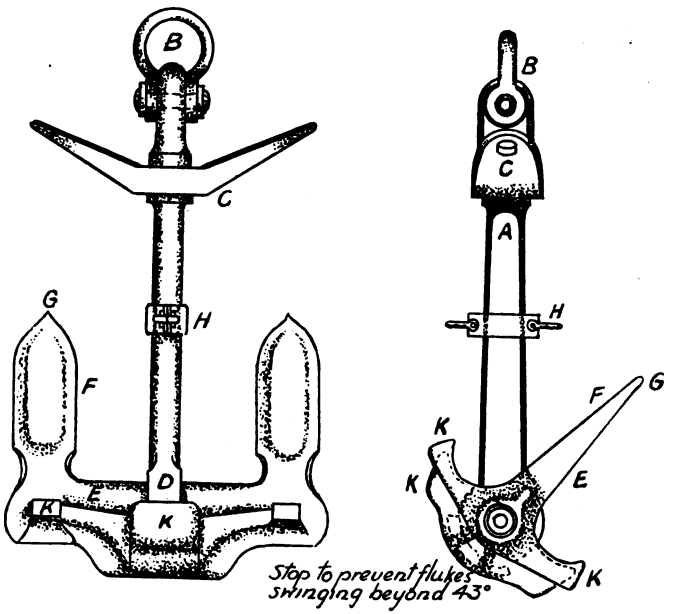
[*To face page* 276.

MARTIN'S CLOSE STOWING ANCHOR.



A Shank.
B Ring.
C Stock.
D Crown.
E Arms.
F Flukes.
G Pea or Bill.
H Gravity Band.
K Tripping Palms.

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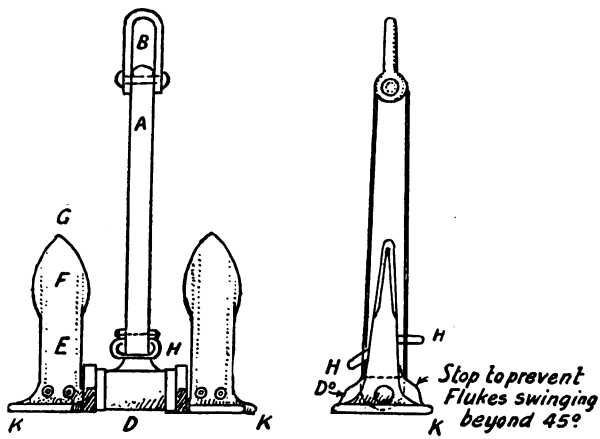
[*To face page* 277.

WASTENEY SMITH'S STOCKLESS ANCHOR.



A Shank.
B Ring.
D Crown.
E Arms.
F Flukes.
G Pea or Bill.
H Gravity Band.
K Tripping Palms.

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the working, are therefore saved by the use of the stockless anchors.

The only disadvantage appears to be that the hawse-pipes have to be made larger, and therefore heavier than for the other type.

Anchors supplied, and their Uses.—The anchors supplied to a ship are :—

Two bowers.
One sheet or spare bower.
One stream.
Two kedge (large and small).
Boats—one to each.

The weight of the bower, sheet and stream anchors carried depends on the weight or displacement of the ship, as the forces brought on an anchor by a ship riding at it will increase with the weight of the ship.

TABLE SHOWING NUMBER AND WEIGHT OF THE VARIOUS ANCHORS CARRIED BY DIFFERENT CLASSES OF SHIPS.

Class of Ship.	Displacement.	No. and weight of—		
		Bower and Sheet Anchors.	Stream Anchors.	Kedge Anchors.
	Tons.			
Battleship	25,000	3 of 149 cwt.	1 of 63 cwt.	1 of 15 cwt. 2 of 5 cwt.
	18,000	3 of 125 cwt.	1 of 42 cwt.	1 of 15 cwt. 2 of 5 cwt.
	14,000	3 of 115 cwt.	1 of 42 cwt.	1 of 16 cwt. 1 of 8 cwt.
Battle Cruiser	26,000	3 of 152 cwt.	1 of 45 cwt.	2 of 7 cwt.
Cruiser	14,600	3 of 115 cwt.	1 of 40 cwt.	1 of 16 cwt. 1 of 12 cwt.
	11,000	3 of 105 cwt.	1 of 35 cwt.	1 of 14 cwt. 1 of 12 cwt.
Cruiser	5,600	3 of 80 cwt.	1 of 24 cwt.	1 of 10 cwt. 1 of 8 cwt.
Cruiser, Light	3,000	3 of 54 cwt.	1 of 14 cwt.	1 of 8 cwt. 1 of 3 cwt.
	2,140	3 of 48 cwt.	1 of 10 cwt.	1 of 8 cwt. 1 of 3 cwt.
Sloop	1,070	3 of 28 cwt.	1 of 9 cwt.	1 of 5 cwt. 1 of 3 cwt.

Destroyers carry two bowers whose weight varies from 7 to 20 cwt. according to displacement. The larger Destroyers also carry one Admiralty Pattern anchor of 3 cwt.

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The weight of boats' anchors are given in the tables on pages 261 and 262.

Bower anchors are used for the ordinary purposes of anchoring and mooring, and are stowed one on each bow.

The sheet or spare bower anchor is a spare anchor to the bowers, and is of the same weight, and is used in case of emergency when the ship is moored. It is carried on the starboard side, with a hawse-pipe just abaft the starboard bower. Merchant vessels do not usually carry a sheet anchor.

The stream anchor is about one-third of the weight of the bower and is generally stowed aft. In some ships it is stowed under the stern walk, in others against the shelter bulkhead. In the latest ships a stern anchor is fitted in a stern hawse pipe; this anchor takes the place of the stream anchor. It is used for holding the ship temporarily in a given position.

In the older ships the stream anchor was used in conjunction with the stream cable, which was stowed in a chain locker fitted just abaft the after armour bulkhead. The stream cable is now abolished, and the stream anchor is worked by a steel wire rope, the reel for which is stowed aft. A Carpenter's wire nipper or a Bullivant's fixed nipper are fitted in the latest ships to hold the wire when the anchor is laid out. The anchor is stowed against the side of the ship and rests in two crutches which are formed on the heads of two vertical bars, the lower ends of which hinge about pins on the ship's side. The anchor is secured by chains fitted with triangular links lashed to similar link plates on the ship's side, and also by two shank painters the lower ends of which are fixed to eye plates on the ship's side under the shank, the upper ends being taken by the horns of a tumbler worked from the quarter deck. When let go the arms fall outboard, and throw the anchor clear of the ship's side. The anchor is weighed by the after capstan, a small davit overhanging the ship's side is fitted on the quarter deck to take the catting pendant, which is held when necessary by the Carpenter's stopper. When running out the steel wire rope passes through a large fairlead on the deck edge. (*See* sketch.)

Kedge anchors are smaller anchors, used for light work such as kedging, warping, or hauling the launch out when laying out a bower or sheet anchor, &c.; they are stowed in any convenient positions, generally against the upper deck casings.

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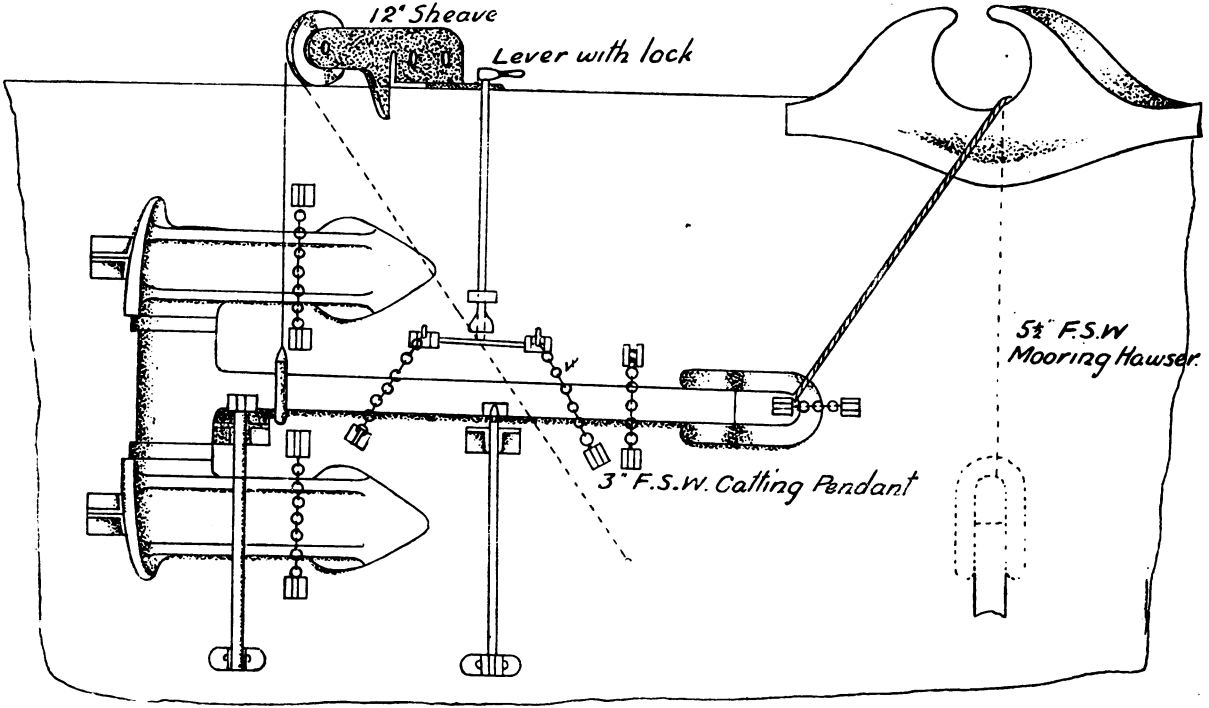
METHOD OF STOWING STREAM ANCHOR.



All securities to anchor are fitted with Slips and Screws, except shank painters ✕, which have screw only.
Painters, &c., are of ¾-in. chain rigging.

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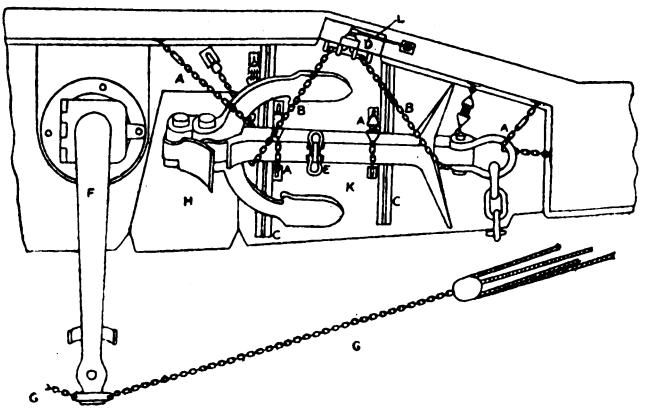
Inglefield's Anchor stowed on Bed.



The figure shows the stowage of a close-stowing anchor. The type shown is Inglefield's, but the fittings are practically the same for other types.

K is the anchor bed, a stout steel plate worked at the side of the upper deck or forecastle, and inclined at about 20 degrees; the outboard edge is rounded over, and well secured to the side plating. H is a recess in the bed to take the tripping palms. C C are **T** bar-skids, secured to the bed, on which the anchor rests, and slides down when let go. B B are two chains, termed "shank painters" or "tumbler chains," which pass round the shank of the anchor, one end of each being fitted with a triangular link, which is secured by lashing to similar links on the bed; the other end of each is fitted with a ring, which fits over two horns on the bolt of the tumbler D; this bolt is also fitted with a spill at its centre; the spill points inboard, and is kept in this position, when the anchor is stowed, by a semi-circular guard attached to a lever L of the tumbler D. By raising L the guard is turned free of the spill, the bolt of the tumbler turns, and releases the ends of the chains B B from the horns.

A A A A are extra securing chains, one passing through the ring of the anchor, one round the inboard arm, and two round the shank; the standing ends of these chains are secured to eye-plates on the bed, the other ends being fitted with triangular links, which are lashed to similar links on the bed with hemp lashing or secured with bottle screws and slips.

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Before letting the anchor go, the extra securing chains A A A A are cast off and the anchor kept in position by the two chains B B.

By raising the lever L the spill on the tumbler is released, the bolt of the tumbler turns, the ends of B B are released from the horns, and the anchor is free to slip off.

F is the cat-davit or cathead which passes through the deck, and stands on a bearing on the deck below. Just above the upper deck it is fitted with a hinge, which allows it to be lowered and stowed flat on the deck; this allows the foremost guns to train over it. It is provided with two blocks, one at the head and the other shackled to an eye on a band, which is free to revolve round the cat-davit near the hinge. G G are the fore and aft guys to the davit.

To stow the anchor the cable is hove in by the cable-holder until the anchor is up to the hawse-pipe; the cat-pendant being then rove from the capstan through the blocks on cat-davit is shackled or hooked to the gravity band on the anchor or to the ground chain, if so fitted. The cat-pendant is then hove taut by the capstan, the cable veered sufficiently to allow the anchor to come directly under the cat-davit, and by heaving up the cat-pendant the anchor is brought up to the level of the bed, and, by then easing the after guy, the anchor is swung over the bed and lowered into its stowing position, and secured by the chains B B.

Close-Stowing Anchor stowed Vertically.

The figure shows a close-stowing anchor stowed vertically against the ship's side. In this case the anchor bed is replaced by a small structure H, built on the outside of the ship, and on which the crown of the anchor rests.

The purpose and fitting of the chains A A and B B are similar to those just described for an Inglefield's anchor. The tumbler D is here placed on the side plating of the ship, and is worked by a lever L from the upper deck. No cat-davit is required, but its place is taken by a "clump cat-head," consisting of two plates and angle structures C C standing out from the side of the ship and supporting the pin of a sheave D, over which the catting pendant F is rove.

The stowage being vertical, when the anchor is hove up to the hawse-pipe the cat-pendant is hooked or shackled to the ring of the anchor instead of to the gravity band, as for a horizontally stowed anchor.

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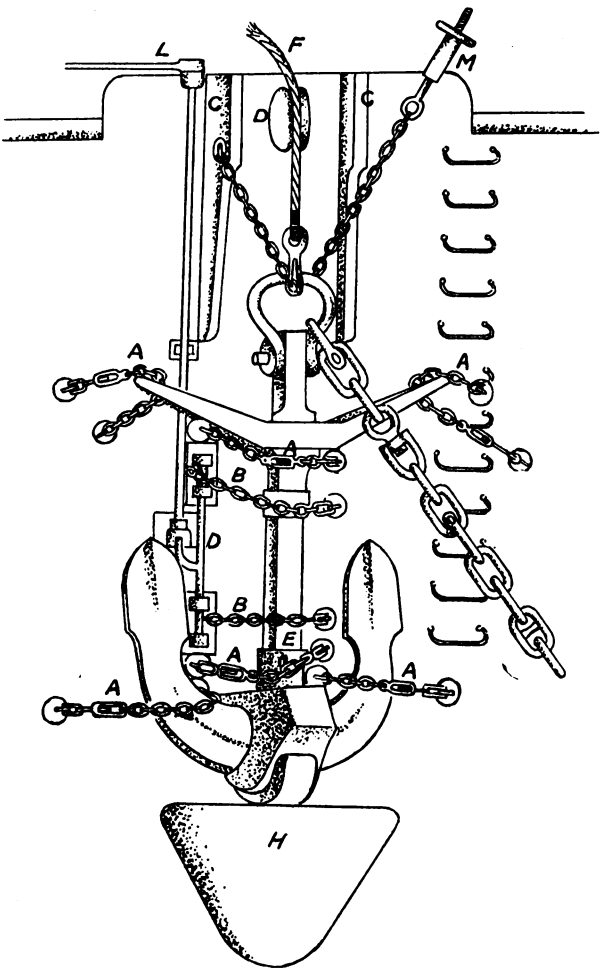
[*To face page* 280.

CLOSE STOWING ANCHOR.
VERTICALLY STOWED.



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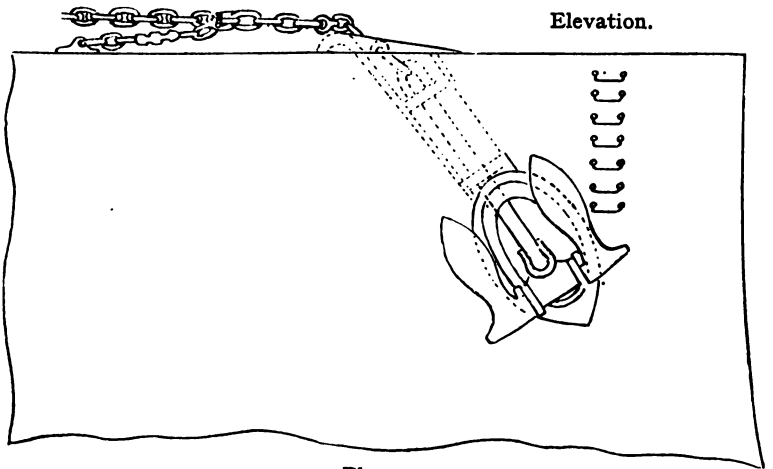
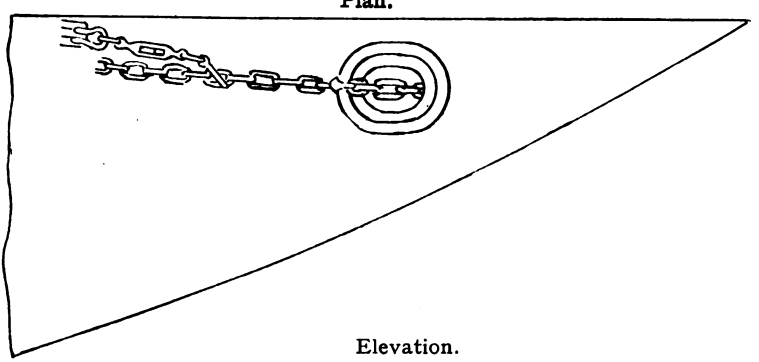
STOWAGE OF STOCKLESS ANCHORS.

A.

Elevation.

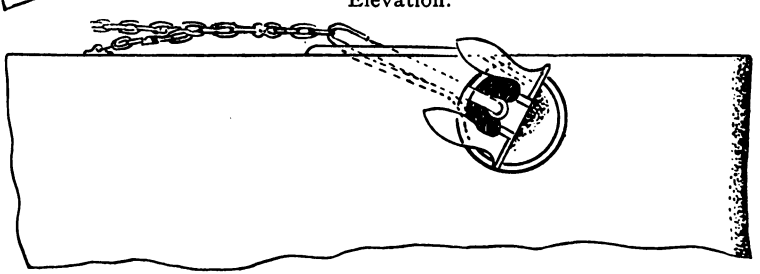


Plan.

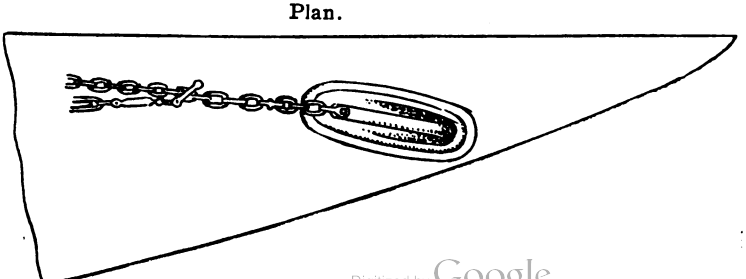


B.

Elevation.



Plan.



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Small adjustments in vertical position can be made by a hand wheel and screw M fitted at the edge of the deck; the end of the screw is connected to a chain which passes through the ring of the anchor, the standing part being secured to an eye-plate C.

In this stowage of anchor no part projects above the deck, as when an ordinary cat-davit is used.

Stockless Anchors.

On the introduction of stockless anchors in H.M. Service, they were stowed as shown in Figure A.

The axis of the hawse-pipe is arranged with a slope of about 30 degrees to the vertical. The anchor is hove up by the cable-holder into the hawse-pipe, and is then secured and hove close home by a screw stopper (*see* page 272). No other fittings are used for securing the anchor.

With the anchor stowed as shown, the crown and arms were near the water, and consequently in a seaway large clouds of spray were thrown over the forecastle and fore bridge by the seas striking against the outboard part of the anchor.

To minimise this as much as possible, in later ships the stowage is arranged as shown in Figure B.

Here the hawse-pipe is inclined at a much greater angle to the vertical, and consequently its outboard end is nearer to the deck edge and further from the water. The height is such that the upper fluke of the anchor when stowed is just above the deck edge.

The lower edge of the outboard end of the hawse-pipe is well rounded, so that as the shank enters the pipe it falls back aft.

Generally the anchor can be hove right home into the pipe by the cable-holder, but sometimes it is necessary to veer the cable slightly so as to let the anchor turn into the correct position before entering.

The anchor is hove close home and secured by the screw stopper.

Cables.

Chain cables vary in size from 3 inches to $\frac{7}{16}$ of an inch. The largest carried by battleships and battle cruisers at present is $2\frac{15}{16}$ and 3 inches respectively.

The size of a cable is the diameter of the iron of which each link is made—it can be measured with a pair of callipers.

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Studded chain, *i.e.*, with bars or studs across the links, is always used for cables; it is stronger than studless chain of the same size, and prevents kinking.

The weight in tons per 100 fathoms = $2{\cdot}4 \times (\text{size})^2$.
The proof strength in tons – – = $18 \times (\text{size})^2$.
The breaking strength in tons – = $27 \times (\text{size})^2$.
The stowage for 100 fathoms – = $35 \times (\text{size})^2$.

All large ships are supplied with three cables, one for each bower anchor (18 shackles each) and one for sheet anchor (8 shackles). In the smaller cruisers only two chain cables are supplied for the bowers, the sheet being worked with a steel wire hawser. A wire hawser (150 fathoms) is now supplied instead of a stream chain cable, a Carpenter's stopper or a fixed Bullivant's nipper being fitted to work it.

Cables are marked at the first shackle with a piece of iron wire round the stud of the first studded link, both *before* and *abaft* the shackle; at the second shackle round the second studded link, and so on.

Studless chain varies in size from $1\frac{5}{8}$ inches to $\frac{1}{8}$ of an inch and is used for boats' grapnels.

Chain cables are stowed in lockers specially built into the ship. In the latest large ships there are three lockers running athwartships, two large lockers for the bower cables and a smaller one for the sheet cable. In the older ships a fourth or spare cable locker was provided. The floor of these lockers is generally the protective deck, and a perforated flat upon which the cable rests when stowed is fitted about two feet above the floor, to allow for the drainage of the cable. The cable clench is secured to the protective deck, and a circular hole is cut in the flat to allow the Senhouse slip to pass through. Small compartments at the side of the ship in the wake of the lockers are provided for stowing the spare cable gear.

A Length or Shackle of Cable is $12\frac{1}{2}$ fathoms long, and has an odd number of links so that the joining shackles always come on the cable holders in the same direction, *i.e.*, vertical.

A Cable's Length is 8 shackles, or 100 fathoms.

Joining Shackle is used for joining the shackles or lengths of cable together, the bolt is flush with the lugs and is kept in place by a tapered steel pin, which is driven in with a hammer and punch, and covered with a leaden pellet which is hammered into the hole over the larger end of the pin and expands into a groove which is cut round the inside of the hole.

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Joining shackles are secured to the cable with the bow of the shackle towards the anchor, otherwise when the cable is running out at a great speed, the jaws of the shackle are liable to catch in the deck or hawse pipes, thus damaging the shackle or fittings.

Anchor Shackle.—In this shackle the bolt projects beyond the lug of the shackle and is kept in place by a forelock, a tapered pin secures the forelock in the same way as the bolt of the joining shackle is secured.

Anchor shackles, stockless or otherwise, are now made for the eyes to pass through the end links of cables, and the bolt made and secured in a similar manner to joining shackles. Anchor shackles are wider in the clear than joining shackles, and are used for securing the cable to the anchor, or to buoys, bow of shackle inboard.

Vessels with cables of $1\frac{7}{8}$ inch and below are allowed a special shackle for securing to buoys.

Reaming a Shackle is clearing the undercut portion of the lug of a shackle from any small deposit of lead which might remain after the pin and pellet are knocked out.

A Swivel is a strong link of iron, one part revolving in the other.

A Swivel Piece consists of a swivel with two links on each end, one studded and one studless, the outer being the studless to take the shackles which secure it to the cable. There are two on each cable, one on the first shackle on the outboard end, and one on the last on the inboard end, to keep the turns out of the cable when at single anchor.

Swivel Piece.

A Blake Slip Stopper is a chain slip stopper shackled to a bolt in the deck for use in temporarily holding the cable; a horizontal link of the cable is held between the tongue and the link of the slip. It is tested to one-third of the proof strength of the cable.

Blake Screw Stopper.—A Blake stopper with a bottle-screw is used for securing and heaving stockless anchors close into the hawse-pipes.

A Blake Stopper Bolt is a deck bolt of the shape shown in the figures of Blake and screw stoppers, and is used to secure them. It has a centre bolt upon which a

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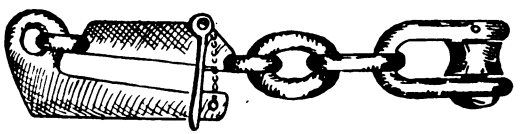
nut is fitted, and hove up on a plate under the deck. Two smaller bolts are fitted in the after end. It is tested to 20 per cent. above the proof test of the Blake stopper. In the older ships it carried a shackle which took the shackle of the Blake stopper, but in the latest ships the shackle of the Blake or screw stopper is bolted direct to the stopper bolt and an extra link added to the Blake stopper to bring the slip vertical.

Lengthening Pieces.—With stockless anchors a lengthening piece of cable of the same size as the chain cable is inserted between the anchor ring and the swivel piece. This lengthening piece is about 10 links long, and is shackled by an anchor shackle to the anchor ring, and by a shackle to the swivel piece. When being towed the cable is unshackled at the after end of the lengthening piece and led forward through the fair lead on bow. The anchor is then held in the hawse pipe by the screw stopper and lengthening piece.

A Clear Hawse Slip is a Blake stopper fitted with a roller shackle at its inner end for reeving a hawser through. Its use is described on page 298.



A Senhouse Slip is a short length of chain of the same strength as the cable, with a slip at one end and a shackle at the other; it is shackled to the cable clench. The slip is put on to the end link of the cable, and is kept triced up to allow it to be easily slipped in case of necessity. The length of chain on the slip is sufficient to allow the slip to come just above the top of the locker.

A cable clench is fitted at the bottom of each cable locker, in a vertical line directly under the deck or navel pipes. It consists of a strong steel forging which is well secured to the structure of the ship. It is tested to 20 per cent. above the proof strength of the cable. In the older ships it is fitted with a link to which the Senhouse slip is shackled (*see* page 274), but in the latest ships the bolt of the shackle passes through the cable clench forging.

Two Senhouse Slips are allowed to each vessel fitted with towing arrangements for connecting towing pendants to towing hawser.

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BLAKE SLIP STOPPER.

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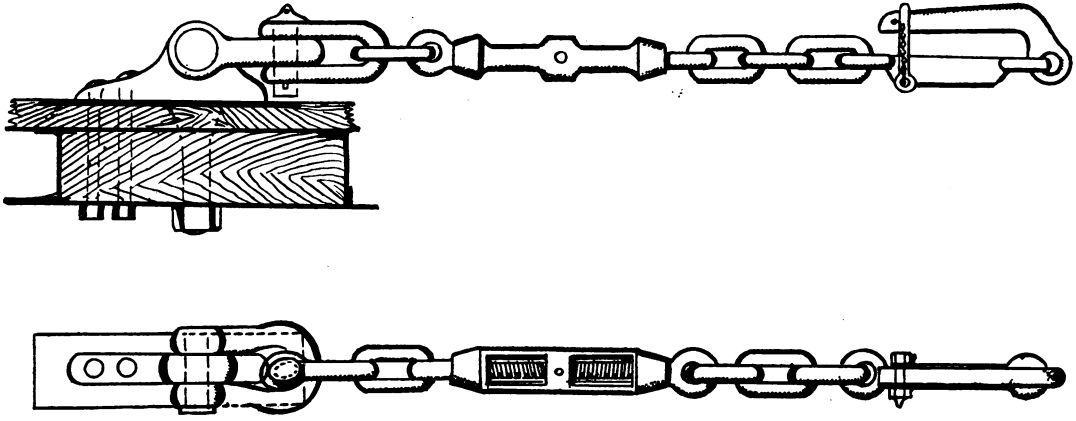
SCREW STOPPER.



A Blake Stopper with a Bottle Screw is used for securing and heaving Stockless Anchors close into the Hawse Pipes.

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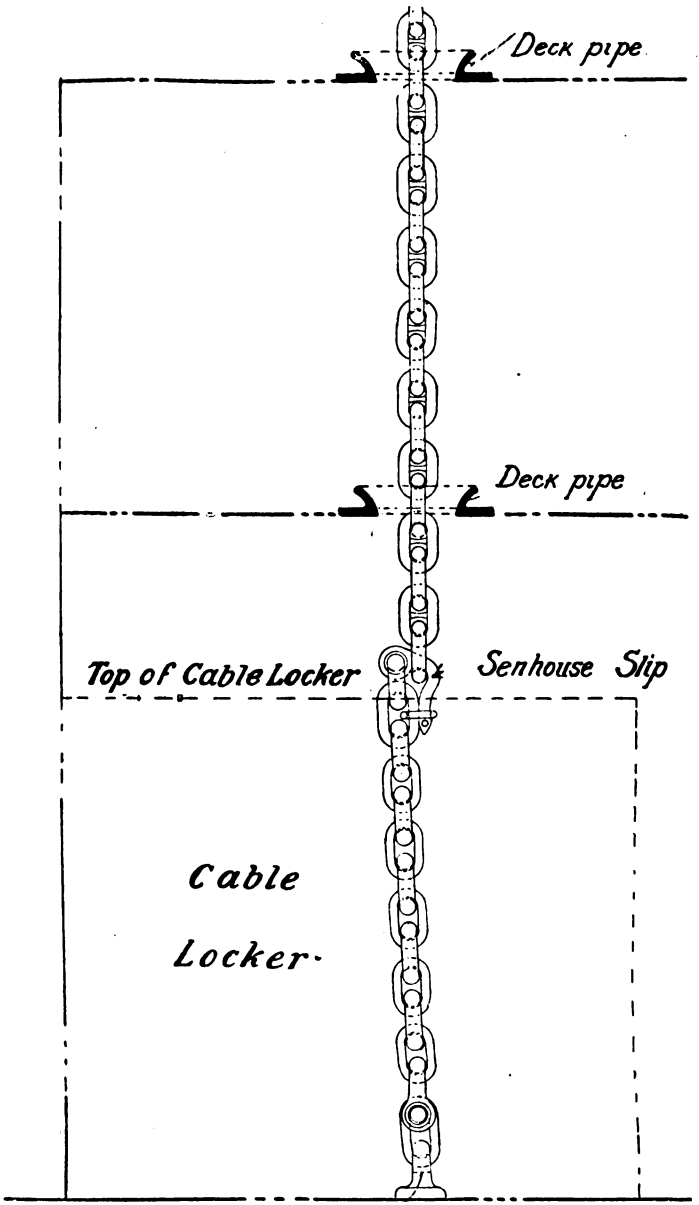

Cable Clench on Floor of Locker.

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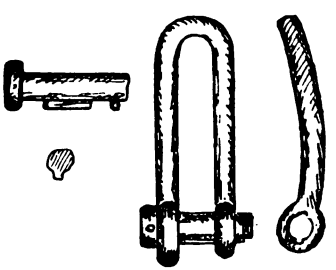
Two anchor shackles are allowed to each vessel fitted with towing arrangements to connect Senhouse slip to outboard end of towing pendant.

Two special shackles ($2\frac{3}{4}$ inches) are allowed for connecting towing hawser to Senhouse slip. One only is allowed to gunboats.

Mooring Swivel.—It consists of a swivel and link secured to two triangular or three-eyed plates; to these eyes are secured studless links, two links to one eye and one to the other on each plate. It is used for keeping the turns out of the cable when the ship is moored. The starboard cable is shackled to the single or odd link, and the port cable to the two or even-numbered links.

A Joggle Shackle is a long, slightly bent shackle; the bolt is fitted with feathers which pass through featherways in the jaws of the shackle, so that when it is in and given a half turn the bolt is locked in its place. It is used for hauling the cable round the bow when mooring.



A Ganger is a length of cable leading from the sheet anchor (when stowed on anchor bed) into the hawse-pipe.

Hawse-pipes are cast steel pipes fitted near the bow of the vessel and running between the upper deck or forecastle and the ship's side; the cables pass through these pipes, and when stockless anchors are used as bowers they are stowed in the hawse-pipes. Large warships have three hawse-pipes, two on the starboard and one on the port bow. The foremost pipe on the starboard bow and the port pipe are for the bower anchors, and the after one on the starboard bow for the sheet. Small warships and merchant ships have only two hawse-pipes, one on each side.

Navel or Deck Pipes are steel pipes in the decks, through which the chain cable passes from the chain lockers to the cable deck. The deck pipes on cable deck are fitted with watertight covers and bonnets, the latter fitting round the cable to keep out water.

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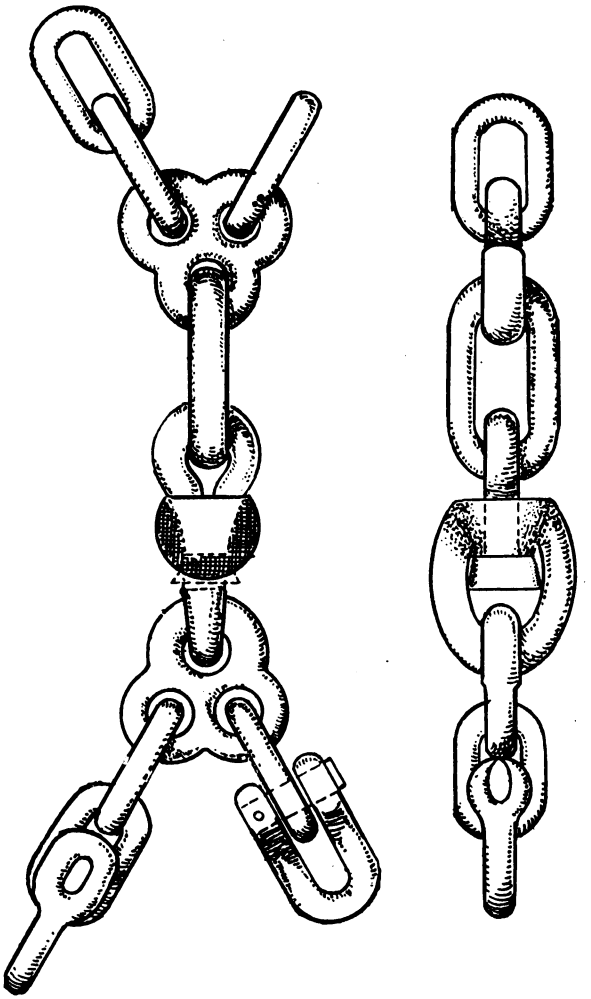

MOORING SWIVEL.

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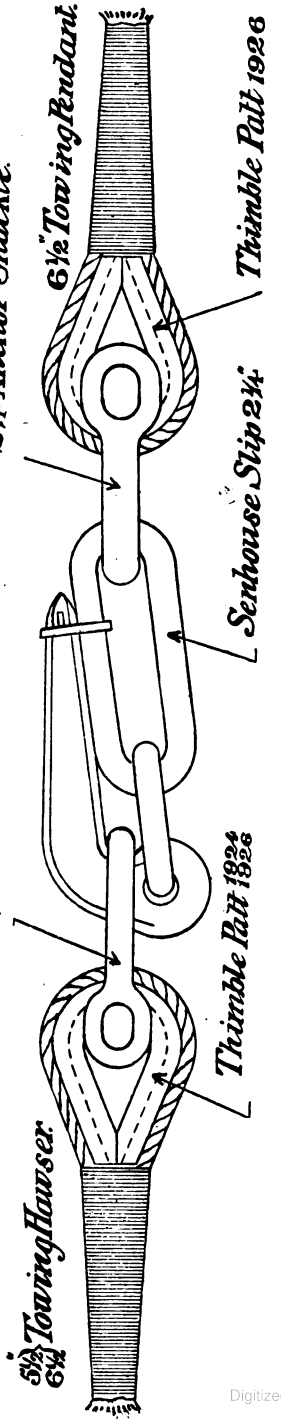

CONNECTION OF SENHOUSE SLIP TO TOWING PENDANT AND TOWING HAWSER.

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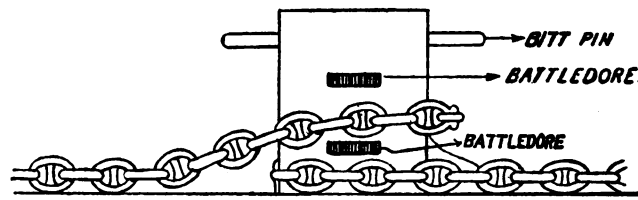
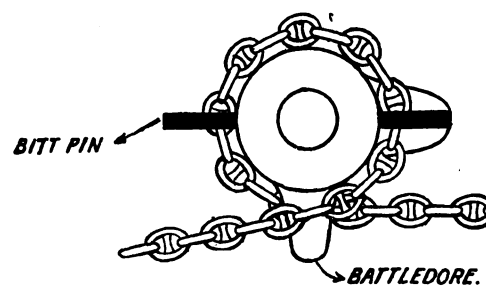
Bitts are cast steel bollards situated between the navel pipes and hawse-pipes used to check the speed of the cable when running out, and for the ship to ride by when at anchor. Bitts are not now fitted to ships with cable-holders except for the sheet cable, and in the latest ships these bitts are omitted.



Inboard End of Cable.

Battledore is used to separate the two parts of the cable round the bitts.

Bitt Pin is used to prevent the cable jumping off the bitts.



Inboard End.

Cable is bitted by hauling up slack chain and getting it just abaft the bitts, the bight of chain is put over bitt-head and eased down, allowing chain to fall in its place over the bitt, the inboard end being on top, and the outboard end underneath the battledore.

The following articles are required for blacksmith's cable work :—

Callipers ; mould for making leaden pellets, and ladle ; reamer ; 2 punches, 1 starting, 1 driving ; 6-inch rule ; hammer.

Screw shackles of various sizes are supplied for general use connected with anchor and cable work.

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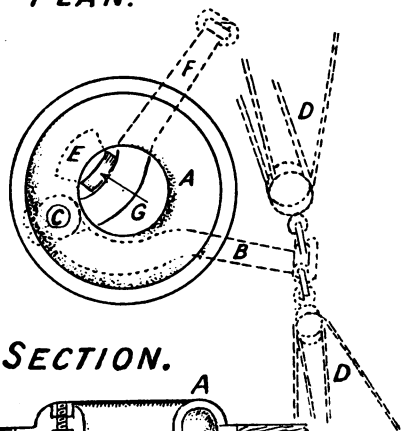
[To face page 289.

COMPRESSOR.

PLAN.



SECTION.

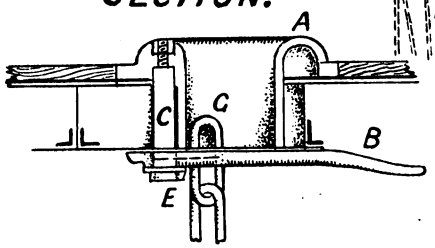


FIG 1

CONTROLLER OR BOW STOPPER.

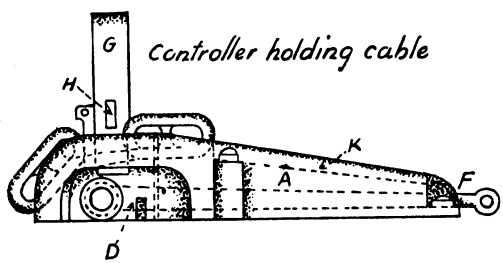


FIG 2

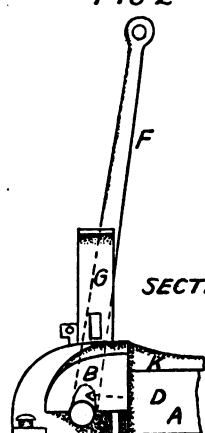
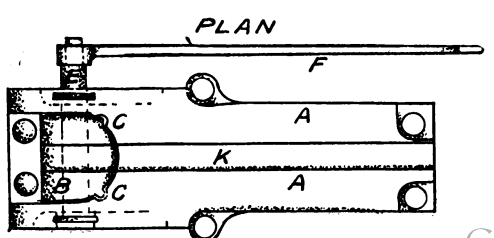


FIG 3



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Cable is hove in by means of a capstan or cable-holder and payed down the navel pipes into the chain lockers.

A Compressor is a bar of steel fitted just below the deck pipe and pivoted about a vertical bolt passing through the deck and pipe; it is used for securing the cable by nipping it against a steel chock or pad piece fitted on the lower side of deck pipe and is worked by tackles, a compressor fall for "bousing to," and a compressor back for "taking off."

The figures show a compressor both in plan and section A is the deck pipe through which the cable passes to or from the cable locker. B is a steel lever turning about the bolt C. D and D are the compressor fall and compressor back, for operating the lever in "bousing to" or "easing back." E is a pad piece fitted just below the lower edge of the deck pipe against which the flat link G of the cable is nipped, when the compressor is boused to as in the position F.

The compressor is fitted to the underside of the deck on which the cables are worked. The cable is nipped on the after edge of the pipe for the bower cables and on the fore side for the sheet cable, where a riding bitt is fitted for the latter. Where three cable holders are fitted the sheet cable is nipped on the after side.

The compressor should never be secured until a good nip has been obtained.

The compressor lever in some of the older ships is made in the shape of a circle which when thrown back corresponds with the hole in the navel pipe, and enables the cable to be boused to the reverse way if the cable-holder is out of action and cable leads down the navel pipe from forward.

The Controller or Bow Stopper is a contrivance fitted in many existing ships, but is not being fitted in the latest ones. It was originally fitted in ships provided only with a middle line capstan and not provided with cable-holders, though the fitting of it was still continued even after the introduction of cable-holders. It was used for holding the cable as it was being hove in link by link. They were fitted one to each hawse-pipe just abaft the inboard end of the pipe and so that the cable had a straight run through them.

Figs. 1 and 2 show a side view of a controller or bow stopper and Fig. 3 a plan. It consists of a steel bed A firmly bolted to the deck and provided with a groove K running along the middle at its upper surface: at the after end is a recess into which fits a block or "hoof," B,

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provided with horns, C, fitting into vertical scores on the bed A. B can slide up and down in the recess, motion being given to it by two cams, D, under it; these cams are keyed to the shaft E which can be turned by the lever F at the side of the bed. A guard or "bonnet," G, fits across the end of the controller, and holes are fitted in it for a fid or pin, H, to stretch across. With the block B in its lowest position and with the fid or pin H across (as in Fig. 1), the cable is held by the flat link being brought up against the vertical end of the recess in A, and the fid prevents the cable rising. If it is required to let the cable run out, as in anchoring or veering, the fid H is removed and the lever F raised (as in Fig. 2), the block B rises and the cable is free to run out over B and A. When the fid is removed from its securing position it is placed under the block B which keeps it in position during the time the cable is running out.

The controller could be used to temporarily check the cable by removing the fid from under the block and putting the lever down.

The guard G is portable, slipping into slots in the sides of the bed A and being kept in position by tapered forelocks driven in at the side.

Wire Rope Stoppers.

There are two kinds in use in the Navy, viz.:—Carpenter's and Bullivant's, both of which are named after the inventors.

Carpenter's Stopper consists of a steel block in two parts hinged together by a screw pin. The hinge is fitted to facilitate placing the hawser in the stopper. The interior of the block is wedged on one side and straight on the other, and a wedge, grooved to fit the lay of the hawser, is attached to the block; on any strain being brought on the hawser the wedge is drawn into the block, thereby jamming the hawser. A hawser is placed in the stopper by opening the stopper and both parts of the block, placing the stopper under and round the hawser; the parts are then closed, the top cover secured, and the wedge driven home. The flap cannot be shut and secured until both parts of the block are closed. By changing the wedge piece the stopper can be used for two sizes of wire, *e.g.*, a 2-inch stopper can be used for a 2½-inch wire, a 3-inch stopper for a 3½-inch wire, and so on. The bridle for securing the stopper to the bolt in the deck consists of a triangular link with two legs, which are secured with shackles to the arms of the stopper. It is used for holding the end of the steel wire towing hawser

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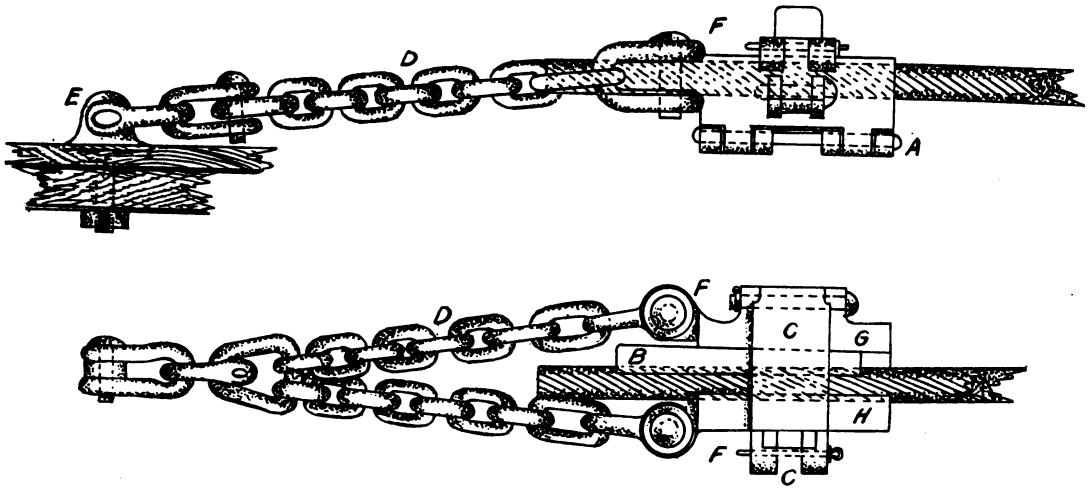
CARPENTER'S STOPPER.



A Screw Pin.
B Sliding Wedge.
C Hinged Cover.
D Bridle Chains.

E Deck Bolt.
F Arms.
G Main Part of Stopper.
H Hinged Side.

[To face page 290.

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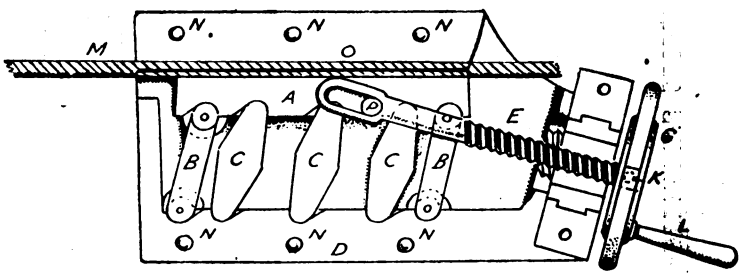
[*To face page* 291.

BULLIVANT'S STEEL WIRE NIPPERS.



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when the latter is brought in on the quarter deck of the towing ship, while being secured to the towing slip. (*See* Volume II.)

Bullivant's Fixed Nipper.

Bullivant's fixed nipper for steel wire rope is shown in the figure. It is fitted in destroyers, torpedo boats, second and third class cruisers, and in all vessels in which the sheet anchor is worked by steel wire rope. It is fitted on the forecastle, or upper deck where there is no forecastle, and in such a position that there is a straight lead from the hawser-reel through the nipper to the sheet hawse-pipe. It is also fitted in the largest ships for working the steel wire rope to the steam anchor.

It consists of a cast steel framing D Q which is laid on the deck and well secured to it by bolts passing through the holes N N. The part Q is the outboard side. A semi-circular groove is cut out of the part of the frame Q, and a similar groove is cut out of the movable part A. Through these grooves the wire rope can pass. The movable piece A is connected to D by the links B B by pins in each end. Distance pieces C C C are also fitted between A and D but are not connected to them. Fixed in the top of A is a pin P which moves in a slot at the end of a screw E, which has a fixed nut F. G is a handwheel turned by a lever L, and fixed to E by a pin passing through both. K is a hole for the insertion of a tommy bar. By turning G in one direction the pin P is forced to the left and forces A against Q, thus nipping the wire in the groove. By turning G in the opposite direction the part A is freed and the wire passes along. By still further turning G in the same direction the pin P is drawn to the right and A moves away from Q, allowing the wire to be lifted clear of the grooves.

Two covering plates are fitted over the top, and a slot between the two directly over the grooves allows the rope to be shipped or unshipped.

It will be seen from its action that the handwheel G must be on the after end of the nipper.

Bullivant's Portable Nipper.

This nipper is much lighter than the fixed nipper and can be placed in any position for use with steel wire rope. It consists of two levers A A of the shape shown. Grooves are cut on the short arms and the levers turn about pins C at the ends of these arms. Cross-pieces D at the top and

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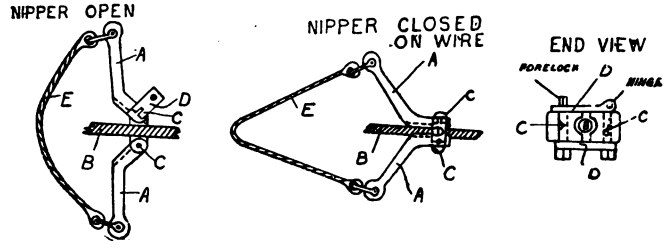
bottom are fitted across the ends of the short arms, the upper cross-piece is hinged at one end, and at the other is kept in place by a forelock passing through a slot in one of the pins C. A bridle of steel wire rope E for the smaller sizes and chain for the larger sizes is connected by shackles to the ends of the longer arms of the levers, and the bight is when in use shackled to an eye-plate or stopper-bolt on the deck.



The figure on the left shows the nipper open with the upper cross-piece D hinged back for the insertion of the steel wire rope B. The figures on the right show the nipper in position with the rope B passing along the grooves and the cross-piece D in position. The steel wire rope can be nipped when required by inserting handspikes under each of the levers A and thus closing home the jaws. In the larger sizes eye-plates are fitted on each side just below the under cross-piece for the connection of lanyards by which the levers can be pulled towards the bight end and the pressure on the rope relaxed.

CAPSTANS AND CABLE HOLDERS.

Battleships and large cruisers are generally provided with a middle line capstan forward, and one aft on the quarter-deck, and with two cable-holders, one on each side of the middle line on the cable deck forward; the capstan and holders forward are worked by steam, the engine in the larger ships being placed under protection—generally on the platform deck—and in the smaller ships on the deck next below the cable deck. The capstan and holders are each mounted on a vertical spindle which runs down to the engine, and is there connected each to a large worm-wheel which is turned by a worm driven by the engine. With this worm method of driving, no strain can be transmitted by the capstan or holders to the engine. Clutches and bevel wheels are fitted in the engine compartment to enable the capstan and cable-holders to be turned in either direction, together or separately. In the latest battleships

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three capstan holders are fitted, one to each bower and one for the sheet cable. The holder for the last cannot, however, be used for heaving in as it is not connected to the capstan engine. It is fitted with a powerful friction brake and is used when letting go the sheet anchor or for riding by it, thus taking the place of the riding bitt fitted in previous ships (*see* page 288). The sheet cable, if out, must be hove in by the capstan or by the starboard bower cable holder.

The capstan aft is worked electrically by a motor and suitable gearing placed under protection, generally in the steering or tiller compartment.

Capstans.—A capstan in its simplest form is a barrel mounted on a vertical spindle for working steel wire or hempen rope. The outline of the barrel is of circular form, the barrel being smallest in diameter at the middle and largest at the top and bottom. The barrel is of this shape to allow the rope round it to surge up or down as the number of turns is increased. It is of cast steel, and it is fitted with projections called "whelps," standing out from 1 to 1½ inches from the body. The whelps are now cast on the barrel, but in older ships they were generally secured to the barrel by tapped bolts. The whelps bite into the rope and cause the force exerted on the rope to be much greater than if the barrel was smooth. Capstans are fixed to their spindle by keys fitting into key-ways in the spindle and barrel. In a steam capstan the lower end of the spindle is connected by wormwheel and worm to the engine. This connection must be of such a nature that when working by hand the capstan and spindle can be disconnected from the wormwheel and gearing. It usually takes the form of two drop bolts which pass through two holes in a circular plate keyed to the lower end of the spindle and fit into holes in the wormwheel just below. With the pins shipped in position the engine can drive the capstan through the wormwheel and pins. When unshipped the capstan and spindle revolve independently of the engine and gearing. In this condition it can be worked by hand.

A frictional coupling is now also fitted and can be used when it is required to veer the capstan without using the engine.

Recesses are provided in the capstan head for shipping the capstan bars for working by hand. The bars are of ash and fitted at the inner ends with cast-steel shoes which fit into the recesses and are secured by pins which pass through the crown-plate and the shoes. The pins are fitted

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with eyes, jacks and chains which are secured to eye-plates in the crown.

To provide against the capstan "walking back" when being worked by hand, "pawls" are fitted to the lower edge; they are held by pins fitting radially into the lower edge of the capstan and can be turned about the pin so as to act in either direction. The pawls gear with teeth formed on a cast-steel rim forming the outer portion of the casting secured to the deck under the capstan; this rim is termed the "pawl bed" or "pawl rim." With all the pawls turned in one direction the capstan can be turned in the opposite direction, the pawls passing over the teeth in the pawl rim; if the capstan tends to "walk back" the pawls engage with the teeth and bring it up. When working the capstan by steam the pawls are not required as the capstan cannot "walk back," being prevented by the worm gearing; and to keep the pawls clear of the teeth when working by steam, "pawl rests" are fitted between them, and these support the toes of the pawls above the teeth. If pawls are left down when working by steam an accident to the capstan would probably occur. In smaller capstans portable plates can be shipped over the pawl rim, the pawls then passing freely over the plates when working by steam. (The pawls and pawl rests are shown in the sketch of the Electrical Capstan, page 284.)

A capstan as fitted in a large ship is shown in the figure of Harfield's capstan; provision is made for working the capstan either by steam or by hand in the event of a break-down to the cable-holders.

From the figure will be seen the cast-steel holder B is provided with "stops" or "snugs" into which the links of the cable fit; it is keyed to the spindle A by two keys C. At the top of B is the barrel Q for working small steel wire or hempen rope. Above Q are the recesses J for the cast-steel shoes of the capstan bars, the pins K preventing the shoes from slipping out; the pins K also serve when shipped to keep the portable whelps I in position for working large steel wire rope. L is the pin through one of the pawls, a forelock passing through it on the inside of the rim of the holder B. R on the other side is a pin to a pawl-rest.

A capstan or drumhead F is fitted between decks to take capstan bars.

Portable rollers (as shown in sketch of cable leads in a modern battleship) are fitted round the capstan to guide the cable when using the middle line capstan. (One of these rollers is shown to the left of the sketch of Harfield's capstan.) Each consists of a cast-steel barrel provided

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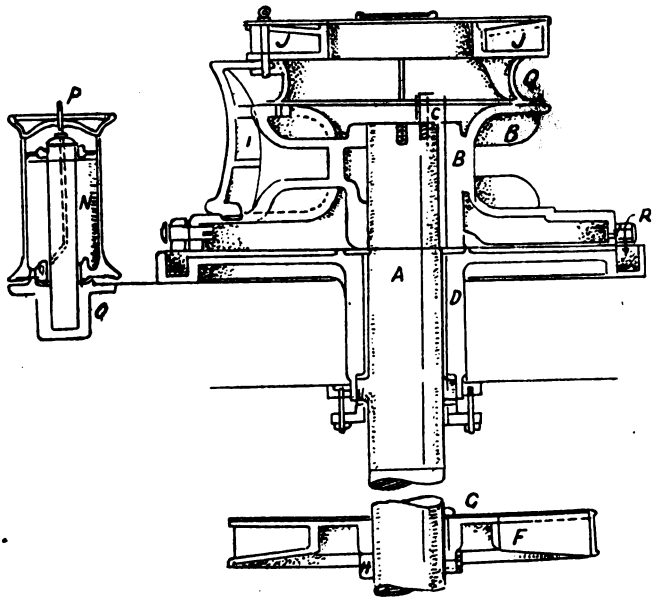
HARFIELD'S CAPSTAN.

For 2½ Cable.



A Spindle.
B Holder with Stops or "Snugs."
C Key.
D Pawl Bed and Deck Connection.
E Stuffing Gland.
F Capstan or Drum Head with Sockets for Bars between Decks.
G Key.
H Collar.
I Portable Whelps for working large Steel Wire Rope.
J Head and Sockets for Bars.
K Pins to Bars and Whelps.
L Pin securing Pawl.
M Tapped Hole for Lifting Spindle.
N Roller.
O Socket.
P Lifting Ring.
Q Barrel.
R Pin and Pawl Rest to support Pawl when latter is not required to Gear with Pawl Bed.

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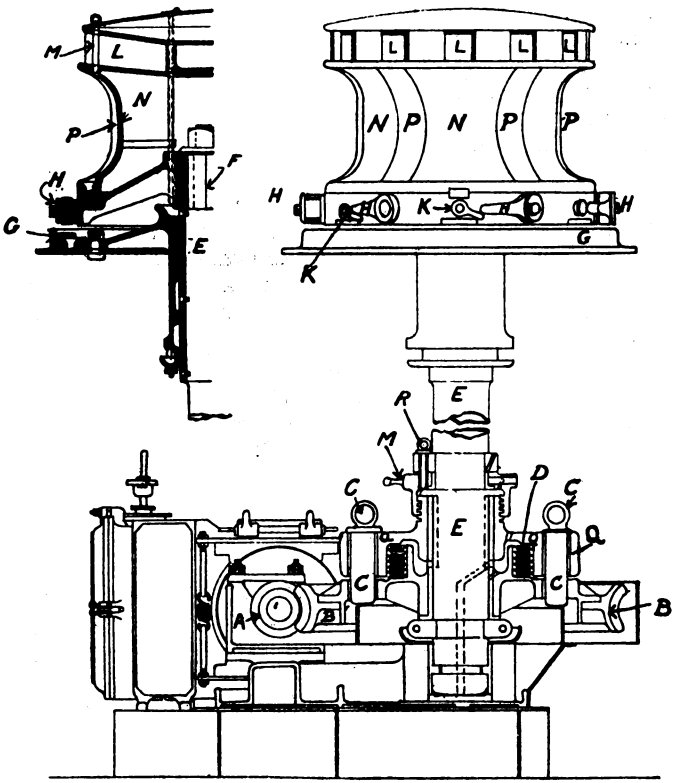
with a lifting ring P; through the middle a pin runs, about which the roller turns; the pin fits into a socket O let into the deck, a key and key-way being fitted to prevent the pin turning in the socket. The sockets are fitted at positions required for the lead of the cables, the rollers being transferred from one socket to another as necessary. Two rollers are usually supplied.

Electrical Capstan.—An electrical capstan as fitted in one of the latest battleships is shown in the figure both in elevation and section. N is a cast-steel barrel on which are cast the whelps P P. E is the spindle to which N is connected by the keys F. H are pawls shown with their

Electrical Capstan.

Section through capstan. Side view.



toes on the pawls-rests K; by turning the pawls over they will clear the rests K and gear with the teeth on the

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pawl rim G; similarly if K is turned over it will support the toe of the next pawl when turned in the opposite direction to that shown. L L are the recesses in the capstan head for taking the shoes of the capstan bars. M in the section is one of the pins for securing the shoes.

A is the driving worm on the motor shaft, B is the wormwheel driven by it; B is not keyed to the spindle E. Q is a circular steel casting keyed on the spindle E and carrying a set of friction plates D which can be jammed against a similar set carried by the wormwheel B. M is a handwheel turning a nut which gears with a thread cut on the upper part of Q. A pin R passes through a collar keyed to E with its lower end passing through a hole in M. With R in place the nut and screw turn together with the spindle E, and the friction plates cannot be put into gear. C C are two drop pins which fit into holes in Q and B; with these pins in place the capstan can be turned in either direction by the motor. But the capstan cannot, however, be veered when the pins C C are in place without reversing the motor; therefore when it is required to heave in and veer, the pins C C are unshipped and also the pin R.

By turning the handwheel M the friction plates D are brought in contact and the capstan is driven by the motor; if it is required to veer, the handwheel M is turned so as to release the plates, and the capstan veers; by jamming the friction plates into contact again the capstan will heave in.

To work by hand the pins C C are unshipped, the friction plates freed, the pin R put in place, the pawls disengaged from the pawl-rests and the bars shipped and rigged; and when manned, the capstan N, spindle E, nut M, and Q revolve together.

The connection of the middle line capstan forward to the engine below is exactly similar to that described above.

When necessary to work a capstan by hand, it is rigged by the carpenter and his crew, who place the shoes and bars in position, and swift the latter together; this is done by means of a *swifter*, which is a 1½ or 2 inch rope fitted with a cut splice in the centre, one end of which is pointed and the other fitted with a thimble.

On the end of each bar there is a slot cut for the reception of the swifter.

To Pass a Swifter.—Place the cut splice in the slot of a bar, take the bight to the next bar placing it in the slot,

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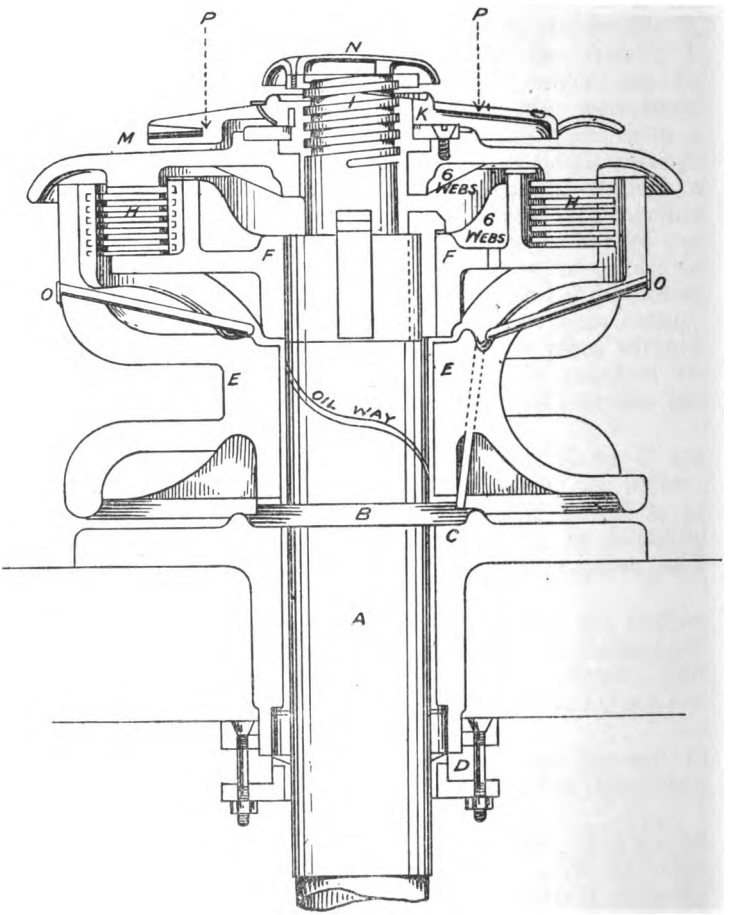
Harfield's Cable Holder. For 2½-inch Cable.



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pass it under the bar through the slot, over the bar inside the swifter, and through the slot again, thus forming a figure of 8.

Care should be taken to haul the swifter well taut as each turn is put over the bars. To finish off reeve the end through the thimble in other end, over nearest bar through the thimble again and hitch.

Bars should be held up while being swifted in so that a fair strain may be brought on all.

Cable-holders are fitted solely for working the cables. The body is cast steel and fitted with stops or snugs into which the links of the cable fit. From four to six of these snugs are fitted on the holders according to the size of cable they are intended to work, the smaller number being for the largest cables.

Cable-holders are not keyed to their spindles, but can revolve freely round them. The spindles at their lower ends are keyed direct to the driving wormwheels. To allow for the engine driving the holders it is necessary to introduce some device by which the holder and the spindle can be connected. The different makers provide for this in slightly different ways. In Harfield's and in Clarke Chapman's holders the connection is made by friction plates. In the figure of Harfield's holder it will be seen that there are 12 of these friction plates marked H made in the form of rings; six of them are connected to the holder E by the feathers G, and six in the same way to a steel casting F which is keyed to the spindle. A nut J at the crown of the holder gears with a screw I cut on the upper end of the spindle. J can be turned by levers inserted in holes M in the circumference of the crown-plate P which is keyed to J. By turning P in one direction the friction plates are jammed together and the spindle and holder move as one; by turning in the opposite direction the friction plates are freed from each other and the holder E turns freely round the spindle A. The collar B on the spindle takes the weight of the holder.

When letting go the anchor the holder with the cable round it turns freely round A and can be checked by jamming down the friction plates; the strain then comes on the spindle A which cannot turn, as the worm gearing at the lower end prevents it. The strain caused by bringing up the cable is thus finally taken on the worm, which, however, does not transmit it to the engine.

In Clarke Chapman's holder the action is somewhat similar, the contact and freeing of the friction plates being brought about in a slightly different manner.

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In Napier's holder, the action is different (*see* next fig.). In this case at the head is a casting A keyed to the spindle B; this casting carries two horizontal bolts C C which can be made to slide radially by pulling the two rings D connected to C by a bolt, the crown-plate K being made portable to allow of this being done. The upper part of the holder E is provided with eight slots F; the bolts C when opposite these slots can be slid into them, and in this position the spindle and holder revolve together. When letting go the anchor the bolts are pushed back out of the slots and the holder can then revolve freely round the spindle. A powerful bandbrake G actuated by a wheel H is fitted round the lower outside edge of the holder, and this is used to check the cable when running out and also to ride by. The whole of the strain when the holder is "brought up" comes on the brake and structure.

Cable-holders are not provided with pawling arrangements or with means for working by hand; therefore, if it is required to work the cables by hand, the midlde line capstan must be used.

In small vessels, such as gunboats, destroyers, and torpedo boats, a capstan only is fitted. This has a bar for working steel wire or hempen rope, and just below the barrel is a cable-holder connected to the barrel and fitted with stops or snugs for working the cable. Pawling arrangements are fitted and the whole can be worked by steam or hand. In such cases the capstan is not keyed to the spindle, but revolves freely on it. Friction plates are fitted to drive the capstan and holder, and to brake the holder when the cable is running out.

Power of Capstans and Holders.—The steam capstan engine forward is of such power that the anchors and cables can be lifted at a rate of 25 feet per minute.

When heaving in slack cable the rate is about 40 feet per minute.

The electrical capstan is generally of sufficient power, in the largest ships, to heave in 10 tons at the rate of 25 feet per minute.

To "Bring-to" Cable.—Put the slip on the cable before the bitts, take off the deck stopper, and put back the compressor, then the slack cable is hauled out of the chain locker, and hung at the navel pipe by a rope lashing, unbitted, and the bight of the cable is hauled round the capstan and rollers.

In all cases cables are to be so put on the cable holders that the joining shackles come on the holder with the pins parallel to the axis of the holder. To enable this to be done, lengths of cable are to contain an odd number of

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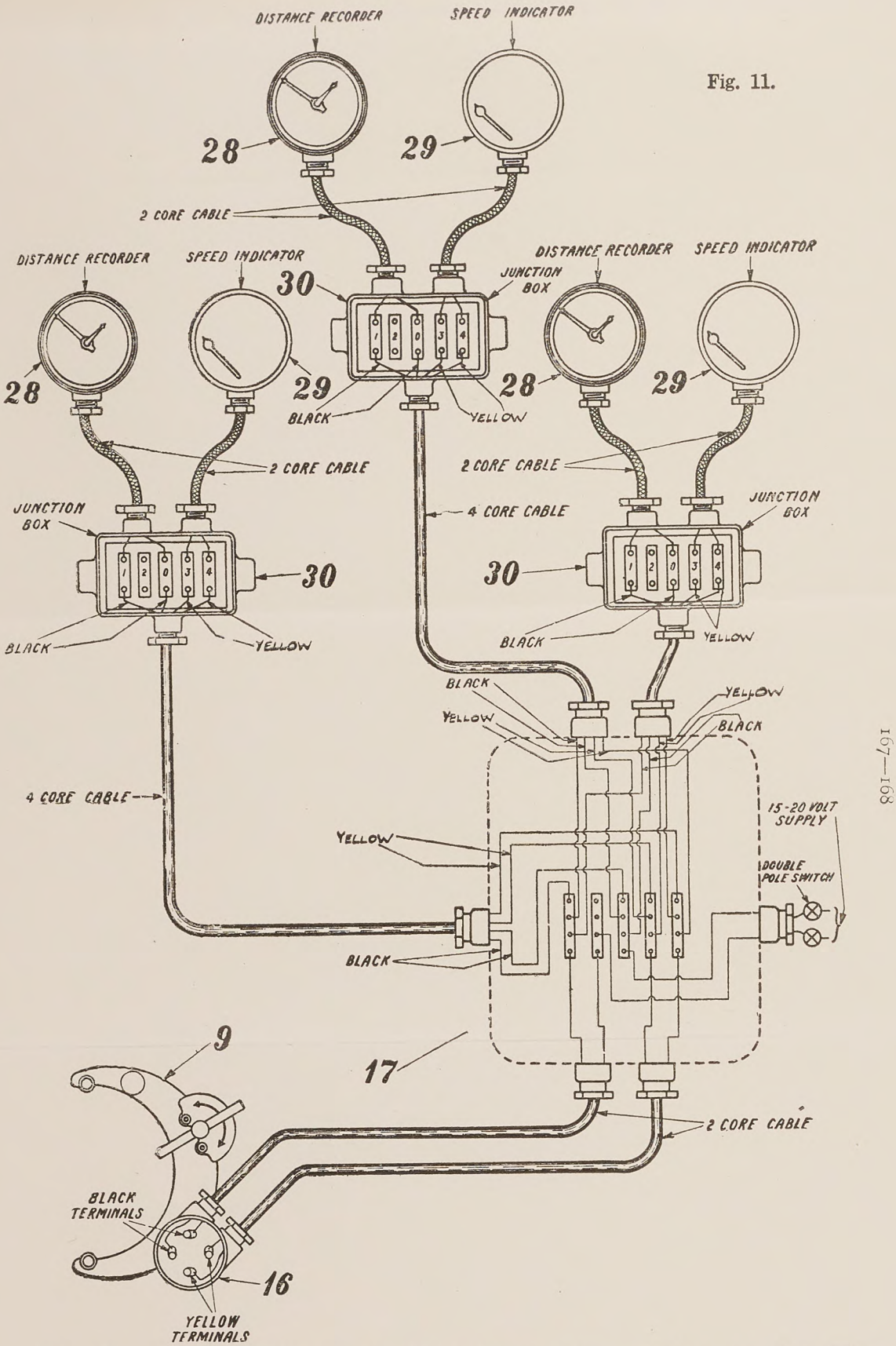
Fig. 11.



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RECEIVING APPARATUS.—Fig. 11 shows the arrangement of three sets of receiving apparatus and the way in which the leads are connected.

Each set consisting of one Distance Recorder *28*, one Speed Indicator *29*, and one Junction Box *30*.

The Distance Recorder registers 1/100 of a knot every electrical contact, the red hand making one revolution per knot, and the black hand one revolution per 100 knots; and the total miles run since Log was fitted is shown by the figures in the window.

The Speed Indicator shows the speed in knots. The Distance Recorder is wound for a 15 volt. circuit. The cables are only required to carry $\frac{1}{4}$ ampere.

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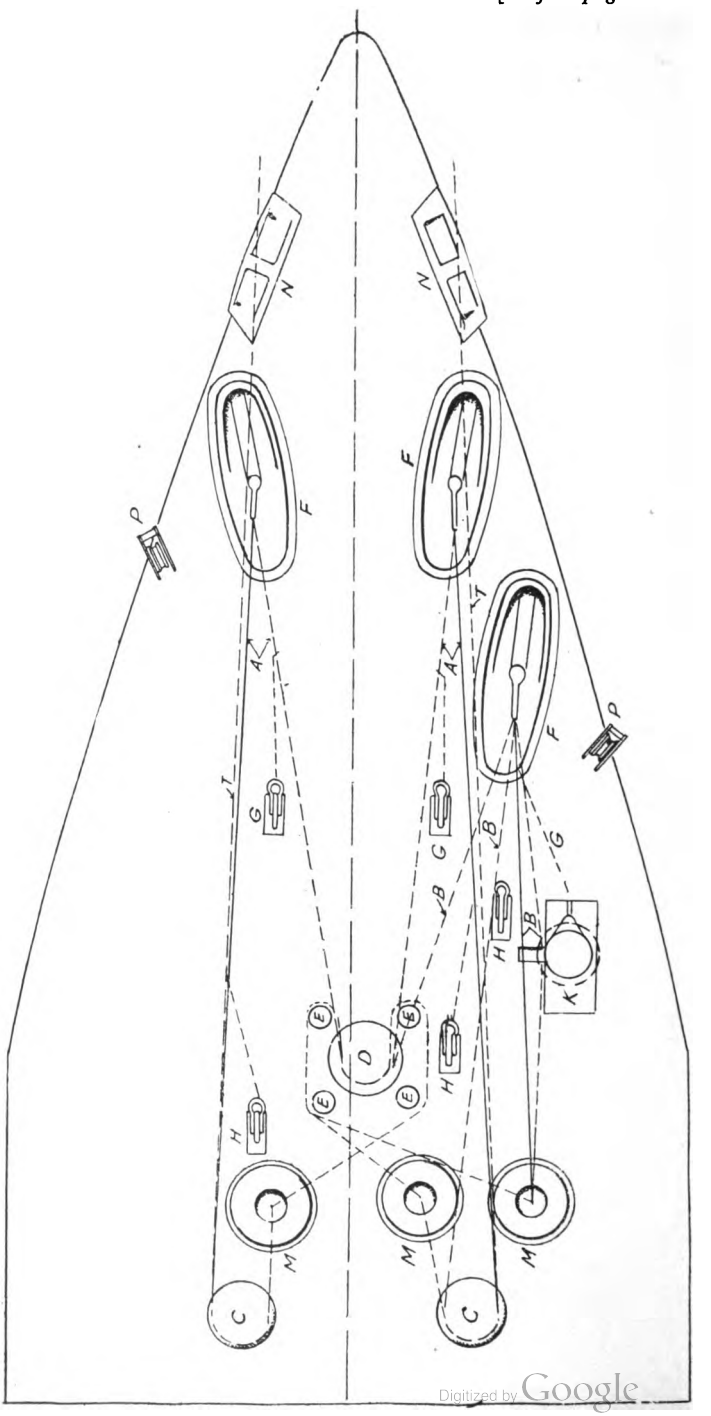
[*To face page* 299.

ARRANGEMENT OF CABLE LEADS IN A MODERN BATTLESHIP.



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links so as to make with the joining shackle attached to each length an even number of pieces to go over the holder.

Ranging Cable consists of hauling enough cable out of the chain locker (to enable the anchor to reach the bottom without being checked), and laying it in long flakes on the deck with the running part nearest the ship's side. In modern ships it is rarely necessary to range cable before anchoring owing to the chain lcokers being well forward, and consequently the weight of the drift of chain between the hawse pipe and the chain locker is not enough to check the anchor when let go, except with stockless anchors, which have no fall to start the cable.

Lead of Cable.—The figure given is a plan of the forecastle deck of a modern battleship.

In the figure D is the capstan, and C C are the cable-holders.

E E E E are deck sockets for the rollers, two of which are supplied.

M M M are the deck or navel pipes.

The full lines marked A show the ordinary lead of the bower cables, that is, from the navel pipes round the aft side of the cable-holder and forward from the outboard side of cable-holder to the hawse-pipe.

The dotted lines marked A show the lead of the bower cables when worked by the capstan, either by steam or hand. In this case the cable comes from the hawse-pipe to the capstan on the same side, passes abaft the capstan and round the foremost roller on the other side of the middle line, round the next roller abaft, and thence to the navel pipe and locker.

The leads of the sheet cable are shown by the lines marked B. The full line shows the cable running direct from the navel pipe to the hawse-pipe. The outside dotted line shows the cable passing round the riding bitt K, *i.e.*, it shows the cable bitted.

The two other dotted lines show the lead round the capstan and starboard cable-holder respectively. It will be seen in the latter case that the cable passes round the holder in the opposite direction to that in which the starboard bower cable passes round.

H H H are Blake stoppers. They can be used to hold the bower cable whilst the cable is taken off the holders and brought to the capstan, or to hold the sheet cable whilst it is being bitted or unbitted, or brought to the capstan or cable-holder.

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G G G are screw stoppers used for securing the anchors when stowed; they can also be used to temporarily hold the cable for any purpose, such as mooring, unmooring, bringing to, &c.

P P are two clump catheads on the deck edge from which the bower anchors are hung when the ship is secured to a buoy by the cable led through the hawse-pipe. The cable to secure to the buoy can either lead through the hawse-pipe or over the fairleads N N.

T T shows the lead of the cables when being towed, the anchors being secured and hung by the screw stoppers G G.

Lengthening pieces of cable are fitted from the rings of the anchors to just aft of the screw stopper to allow for unshackling the cables from the lengthening piece when being towed.

An Anchor Buoy is a wooden barricoe fitted with cork, the ends being strengthened with an additional head, and fitted with wire slings. It is secured to the anchor by means of a buoy rope, thereby marking the position of an anchor when on the bottom.

Care must be taken when anchoring to allow sufficient buoy-rope for the depth of water and rise and fall of the tide.

The buoy-rope is from 20 to 25 fathoms long, and is usually bent to the buoy by passing it through the eye in the slings, single sheet bend, and seizing the ends back.

Usually a short length of small chain is used between the buoy-rope and the anchor to avoid chafe on the bottom, and it is shackled to the crown of the anchor.

A buoy is said to "watch" when it is floating and not carried under the surface by the strength of the tide or other causes.

Anchoring.

The anchors, which have been specially secured for sea, are cleared away, the compressors put back, the cable-holders slacked back, and the chain lockers uncovered; if fitted with one, the controller is put up. If using bitts, the cable is bitted, but since the introduction of cable-holders bitts are not generally used; the cable can be easily checked in running out by the cable-holders. In a vertically stowed anchor the ring chain is cleared away in addition to the sea securing chains. The anchors are thus held now by

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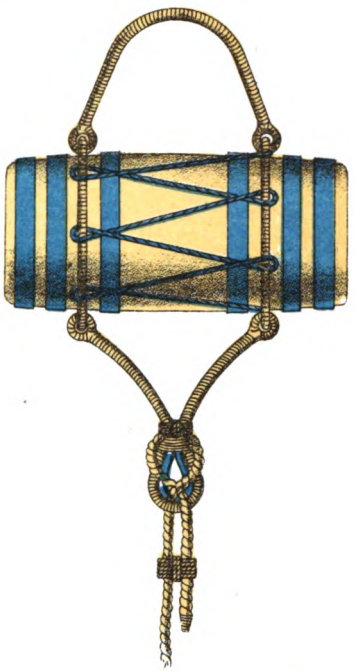
ANCHOR BUOY.



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the tumbler and tumbler chains or, if a stockless anchor, by the screw stopper.

Anchor buoy and buoy-rope are cleared away, latter coiled down and bent to buoy and anchor.

If it is found necessary on account of the chain lockers being some distance from the hawse-pipes that the cable does not run out when the anchor is let go, it is advisable to range a few links of slack cable before the cable-holder. By doing this the force holding the anchor is reduced by the weight of the overhanging cable between the deck pipe and the locker, and there only remains the friction of the cable on the deck.

The first order on coming to an anchor will be to "Stream the buoy." The buoy is then eased down by means of the buoy-rope close to the water and the buoy-rope thrown clear of the ship's side. At this order everyone stands clear of the cable.

The next order is to "Let go." At this order the pin of the releasing lever is removed and the lever hauled aft, releasing the tumbler chains, which allows the anchor to slide off the anchor bed. A lanyard is attached to the lever to assist in hauling it aft. With a stockless anchor the slip of the screw stopped is knocked off.

As a precaution a handspike is provided in case the anchor hangs, in the event of which it would be placed under the anchor, and by bearing up on the handspike it will assist to start the anchor. The cable must be allowed to run out until the ship has lost her way, and not snubbed as soon as the amount ordered has run out, or it may part. When the ship has lost her way the cable can be gradually checked from running out by applying a little extra friction with the cable-holder. When the ship has got the amount of cable ordered (heaving in some if necessary), the compressor is boused to, care being taken to obtain a good nip; the cable-holder is then eased up and re-set up.

Small numerical hand flags are used to indicate the number of the shackles as they run out. When mooring with a fleet the revolution flags are used as the cable flags for the information of the other ships.

On coming to an anchorage, the speed of the ship, as a rule, is generally reduced to about 6 knots when within a mile of where the anchor is to be let go, but this is governed by the strength and direction of wind and tide. There is no arbitrary rule as to when to stop the engines—the state of tide and wind, &c., must be considered—but generally when two cables from the position of letting go, and the engines reversed when the anchor is let go, the object being to have the way off the ship when she

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has got her cable. At single anchor the amount of cable required is about five to seven times the depth of water, but circumstances, such as bad holding ground or exposed position, must be considered.

Weighing Anchor.

The first thing is to reeve the anchor gear, turn out the cat-davit and secure the guys, the after one of which is fitted with a tackle for easing the anchor on to the bed when catted. The cat-pendant is rove from the central capstan through a leading block at foot of cat-davit, through the block at the davit head, and taken forward outside all and secured to a bolt immediately over the hawse pipe. The fire main on forecastle is rigged, and the hose led forward over the hawse-pipe and a branch pipe screwed on, buckets and cloths provided for cleaning the cable as it comes in; two placing jiggers and strops provided at the anchor bed, chain locker uncovered; steam put on the capstan engine, the slip on the cable, and cable-holder connected. When ready, the compressor is put back and the cable hove in, the slip being knocked off as cable tautens; as the cable comes in it is cleaned and payed down into the chain locker and stowed by men specially stationed. The small numerical flags are used, as in anchoring, to indicate the number of the shackles as they come in. The officer in charge should keep the Captain informed as to how the cable is growing, and when the cable is upright from the anchor to the hawse-pipe it is reported as "Up and down" (this is usually done by showing a small U flag), and when the anchor is broken out of the ground it is reported as being "Aweigh" (this is usually done by displaying a small A flag). As soon as the anchor is sighted it is reported as either being "Clear" or "Foul" (this is also usually done by displaying a small "affirmative" or "negative" flag). When high enough, avast heaving, on slip, ease the cable back to the slip, shackle or hook the cat-pendant to balancing band of the anchor, then heave taut the cat-pendant, slack back the cable-holders; when the cat-pendant is taut, surge, by knocking off the slip, and tauten up cable-holder when sufficient cable has run out. As the anchor comes up to cat-davit, ease the after guy and allow davit to swing the anchor over the bed. The strops and jiggers are now used to place the anchor, and as soon as it is placed, reeve and secure tumbler chains, down tumbler lever, and in pin, then heave in slack cable, taking care that it is under the thumb-cleats on the ship's side. While the anchor is being catted the buoy-rope is caught

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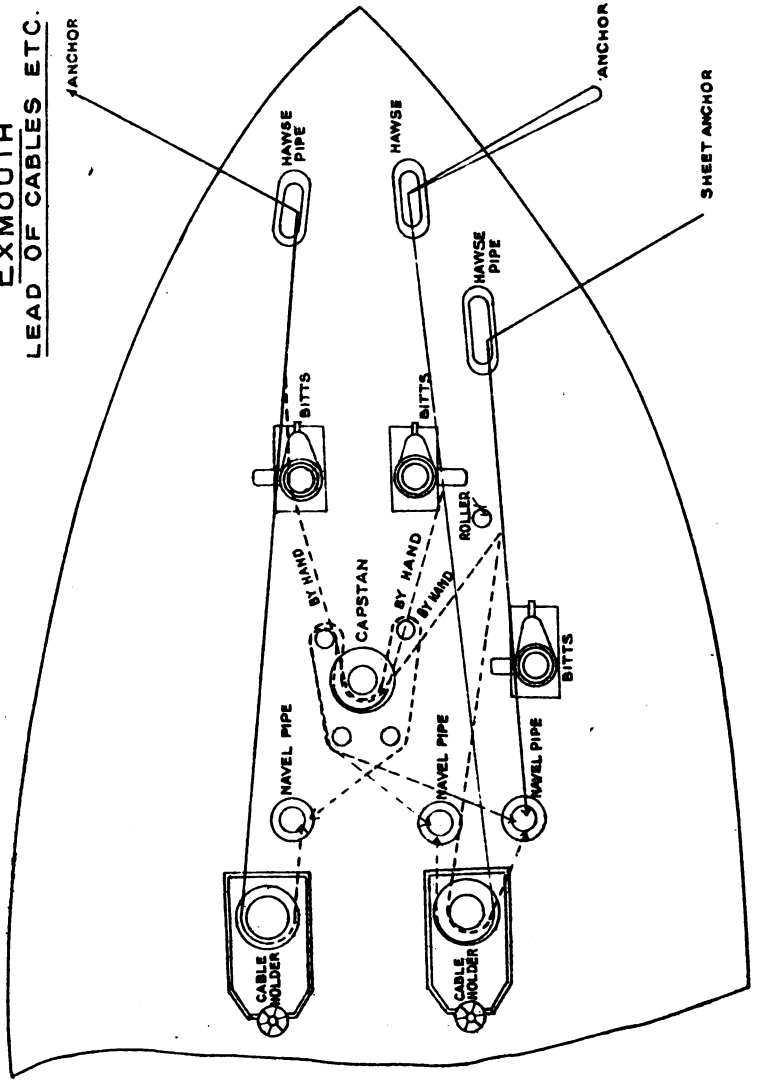
"EXMOUTH"
LEAD OF CABLES ETC.



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by a grapnel and the buoy and buoy-rope hauled in. The anchor gear is then unrove, anchor cleaned, and the cat-davit turned fore and aft and secured, or got down as necessary. The anchor is then either secured for sea or kept ready for letting go again. In catting the anchor the end of the cat-pendant round the capstan should be manned and kept taut.

Weighing in ships with vertically stowed anchors, the operations are similar, except that the cat-pendant reeves through the sheave over the position where the anchor stows, and is either hooked or shackled to the ring of the anchor, and in addition to the placing tackles, a claw worked by a wheel and screw from inboard is fitted for bousing the anchor into the side.

Weighing in ships with stockless anchors, the anchor is simply hove up into the hawse-pipe and secured with a screw slip and Blake stopper. With these anchors care should be taken to stop "heaving in" in time, otherwise if the anchor brings up in the hawse-pipe an accident is liable to occur.

To Weigh with Central Capstan.

The operation is similar to that already described, with the following differences:—

After the slip has been put on, the compressor is put back, and then sufficient cable to "bring to" is hauled up; the cable is then unbitted, and brought to the capstan. Hook ropes and chain hooks are used for this.

The cable is brought to the capstan as follows:—

Two rollers (*a a*) for port cable, or (*b b*) for starboard cable, are shipped on the opposite side of the capstan to the cable. The cable is then brought aft round the sprocket of capstan forward round foremost roller and aft outside both rollers to navel pipe. The foremost roller keeps the cable on the sprocket, and the after one keeps the inboard part of the cable clear of capstan. The cable should be kept lighted along from the rollers to navel pipe by chain hooks.

The capstan is then hove round and the slip knocked off; when high enough for hooking or shackling the cat-pendant, avast heaving and on slip; when the slip is on, the capstan is walked back to the slip, the cable then taken off the capstan and bitted, and cat-pendant brought to the capstan. The cable is surged, as before, by knocking off the slip, a sufficient quantity, if necessary, having been kept up and ranged, and the compressor boused to.

Note.—Where a ground chain is used, one end is shackled to the balancing band of the anchor and the remainder

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stopped along the cable, and the end secured to a small slip on the cable. In weighing, "avast heaving" as soon as the end of the ground chain comes inside the hawse-pipe, when it is then shackled to the cat-pendant, the end of which has been rove in through the hawse-pipe and secured inboard instead of to a bolt over the hawse-pipe in ship's side.

The ground chain is seldom used now. It had few advantages and many disadvantages, and four times out of six it was found that it had become disengaged from the small slip on the cable, chafed the stops off the cable on the bottom, and, consequently, the anchor had to be catted by the ring instead of the balancing band, or the ground chain under-run, either of which caused considerable delay in getting the anchor placed and secured.

To Weigh by Hand.

The cable is brought to the capstan, as previously described, the capstan bars shipped and "swifted to." The 'tween deck drum head is similarly rigged, and when ready, both capstans are manned and pawls put down. The anchor is then weighed, and when high enough the slip is put on and the capstan hove round a little and the pawls lifted, and then the capstan is walked back until the slip has the weight of the anchor. The cable is then taken off the capstan and bitted, the requisite amount of cable for catting is ranged along, the remainder payed below, and the compressor boused to. The cat-pendant is rove as usual, and the inboard end, instead of being taken to the capstan, is rove through a leading block and shackled to the foremost block of the cat-purchase (which has been previously rove), the after block of which is shackled to a special eye-bolt, the purchase is manned and hauled taut, and when well taut the cable is surged by knocking off the slip. A small handspike or crowbar with a lanyard on each end is lashed to the upper part of the foremost cat-purchase block and the lanyards attended by a couple of men to prevent the block slewing and taking turns in the purchase. The anchor is then catted, as before described, and when secured on the bed the capstans are unrigged and purchase unrove, and slack cable hauled in with a tackle.

Weighing with Deck Tackles.

Two large purchases are rove (three-fold for a large ship and two-fold for a small one), to the eyes of the foremost blocks are shackled two Blake stoppers, the after blocks are shackled to special eyebolts in the deck, both

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tackles are overhauled forward to the hawse-pipe, the Blake stopper of one is secured to the cable, and the purchase is manned and hauled in. When the first purchase is far enough aft the deck Blake slip is put on the cable and the first purchase taken off and overhauled forward, and the Blake slip of second purchase put on the cable, the purchase manned and hauled in, knocking off the deck Blake slip. This operation is repeated with each purchase in turn until the anchor is high enough to hook or shackle the cat-pendant to the balancing band; the anchor is then catted, as described in "Catting by Hand."

Mooring.

The object of mooring is to occupy less room than when swinging round at single anchor. A ship properly moored should swing round between her two anchors, being pivoted roughly about her stem. A mooring swivel is always used in mooring, otherwise as the ship swung round she would twist her two cables round each other. This always occurs with merchant ships, who seldom use a mooring swivel, and consequently gives them endless trouble in clearing their cables. The disadvantage of mooring is that the ship is not always riding in a line with her anchors, and therefore if blowing hard from the direction of open hawse, that is at right angles to the line of the anchors, the ship is riding by a span from her two anchors, and therefore bringing an unfair stress on her cables. It is always desirable, where practicable, to lay the anchors, when mooring, *in line with the prevailing wind and tide;* when mooring in a river, the anchors should be laid *in line with the stream.* Veering cable to a strong wind is of little advantage, even if the wind is in the direction of the line of anchors; at the best no benefit is derived from being at single anchor, and a second anchor is down which is of no use; and if the wind is in the direction of open hawse the stress on the cable is only slightly reduced. The amount of cable allowed on each anchor when mooring is generally the amount that would be allowed if going to lie at single anchor, therefore as a rule ships generally moor with six shackles on each cable. *The weather anchor is always, if possible, let go first,* so as to keep the hawse clear while mooring and to avoid drifting over the cable. The amount of cable veered on the first anchor before letting go the second anchor is, as a rule, one shackle less than the sum of the number of shackles that are to be on each cable; thus, if going to moor with six shackles on each, veer

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to 11 shackles on first cable before letting go second anchor. If mooring where there is a considerable rise and fall of tide, or the depth of water is considerable, the second anchor would be let go a little sooner than otherwise. After letting go the first anchor, the ship should be kept perfectly steady on her course, otherwise the cable will be laid in a curve. The engines should not be stopped so soon as in coming to a single anchor, as it is necessary to keep sufficient way on the ship to run out the requisite amount of cable and to run it out fairly taut.

To Moor Ship.

(*Six Shackles on each Cable.*)

(1) Using cable-holders and central capstan.

Anchors and cables are cleared away as in coming to a single anchor, the mooring swivel prepared and placed on the side on which the first anchor is to be let go, or on the side of which will be the riding cable, with the cup of the swivel aft.

The first anchor (say the starboard) having been let go, the requisite amount of cable is run out and then the second anchor let go; the starboard cable is then shortened in and a wire pendant with a joggle shackle in the end is passed out of starboard hawse-pipe and in at the port. While the starboard cable is being shortened in the port cable is being veered. As soon as the sixth shackle of the port cable is just abaft the slip the joggle shackle is shackled to the cable just before the sixth shackle and the wire pendant hove in by the central capstan, still veering on the port cable; the bight of the port cable is thus hove in the starboard hawse-pipe. It will be necessary to surge the wire occasionally during this operation, as the capstan will heave the bight in quicker than the cable-holder will veer. When the bight of port cable is well in the starboard hawse-pipe a Blake slip is put on the outboard part of port cable and inboard part secured, the joggle shackle is then taken off and the cable unshackled and shackled to the two opposite legs of the mooring swivel with the even links. As soon as the sixth shackle of starboard cable is abaft the slip, the slip is put on, the cable unshackled and shackled to the two opposite legs of mooring swivel with the odd links; the starboard cable is then hove taut, both slips knocked off, and then the starboard cable veered until the swivel is at the water's edge; the slack of the port bridle is then hove in and left sufficiently slack to prevent the swivel binding across the stem, and both compressors boused to and secured.

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Another method is to put the slip on the port cable at the fifth shackle, continue walking back the port cable holder until the sixth shackle is up, then shackle on the joggle shackle and haul the bight round as before; but such a taut moor cannot be made this way, as the second anchor must be dropped a little sooner to allow for the shackle of cable going round the bow.

(2) Using central capstan only.

The starboard anchor having been let go as before, and the requisite amount of cable run out, the port anchor is let go. The slip is now put on the starboard cable and the cable brought to the capstan and shortened in, the port cable being veered. The wire pendant and joggle shackle is passed out of the starboard and in to the port hawse-pipe. When the fifth shackle of port cable is just abaft the slip, the slip is put on and the cable hauled up and unshackled at the sixth shackle, and the joggle shackle shackled on and the wire pendant brought to the barrel of the capstan and hove in. As soon as the sixth shackle of starboard cable is abaft the slip, the slip is put on, the starboard compressor boused to, and the cable taken off the capstan and unshackled at the sixth shackle and shackled on to the two opposite odd-numbered links of the mooring swivel, the sixth shackle of port cable which has been hove in by the wire pendant is shackled to the other outer leg of the mooring swivel, the wire pendant is passed round the bows again and shackled to the inboard part of port cable which is hove round and brought in and shackled to the remaining inboard leg of the mooring swivel. The port slip is then knocked off, the starboard cable is brought to the capstan and the swivel eased out to the water's edge, the slip put on starboard cable and the cable taken off the capstan, payed below and the compressor boused to. The slack of port bridle is then hove in and the port compressor boused to. If desired, the bridle of the port cable could be shackled on after the mooring swivel has been eased out.

Unmooring.

In unmooring, *the lee anchor is always weighed first*, and it is customary and also advisable to take the swivel off on the side of the riding cable. Whether unmooring with cable-holders or with only a central capstan the principle is the same. The riding cable is hove in until the swivel is abaft the slip, the lee cable being veered. When the swivel is abaft the slip, the slip is put on the

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outboard part of the lee cable, the inboard end of which is lashed; the two parts of the lee cable are then unshackled from the mooring swivel and shackled together; the lashing on the inboard end of the cable is then cast off, and the slip is then knocked off. Great care should be taken in tracing the parts of the lee cable through the weather hawse-pipe, otherwise the two parts of lee cable may be shackled together with a cross or elbow round the riding cable. The lee cable having run out clear, the slip is put on the weather cable and the two parts unshackled from the mooring swivel and shackled together; the slip is then knocked off, the lee cable is then shortened in and the weather cable veered untll the lee cable is up and down. As soon as the lee anchor is weighed the weather cable is shortened in and the lee anchor stowed.

Mooring Head and Stern.

Should it be necessary to moor head and stern, the following is a convenient method:—One of the bower anchors is used for the stern anchor and a large wire hawser is flaked down on the quarterdeck, the end led out of the fairlead on the quarter and taken forward outside all and clear of all obstructions and led in through the bower hawse-pipe and shackled on to the second shackle of the bower cable, the hawser is stopped along the ship's side with light stops, the end of the hawser on the quarterdeck secured to the bollards, and each flake secured with a stop. Assuming it is desired to moor with four shackles on each cable, three shackles must be got aft along the deck with the end right aft. When the ship arrives in position the bower anchor that is to become the stern anchor is let go. The stops along the ship's side will carry away as the hawser draws aft. On arriving at the position, the bower anchor is let go and the ship's way entirely checked; the stern wire is then hove in until the second shackle is inboard, when the Blake slip is put on; the wire is then taken off and the end of the cable shackled on. The bower cable is veered during this operation. The other end of the cable is shackled to a hawser from forward which is taken round the capstan. When this has been done the Blake slip is knocked off and the bower cable is now shortened in and the stern cable veered by the wire hawser until the fourth shackle is awash, when the slip is put on and the cable secured to the bollards; the slip can then be knocked off. The bower cable is secured when the fourth shackle is awash.

To Unmoor.—A large wire hawser is led aft from the bow hawse-pipe outside all and brought in the same fair lead on the quarter as the cable is in. The slip is put

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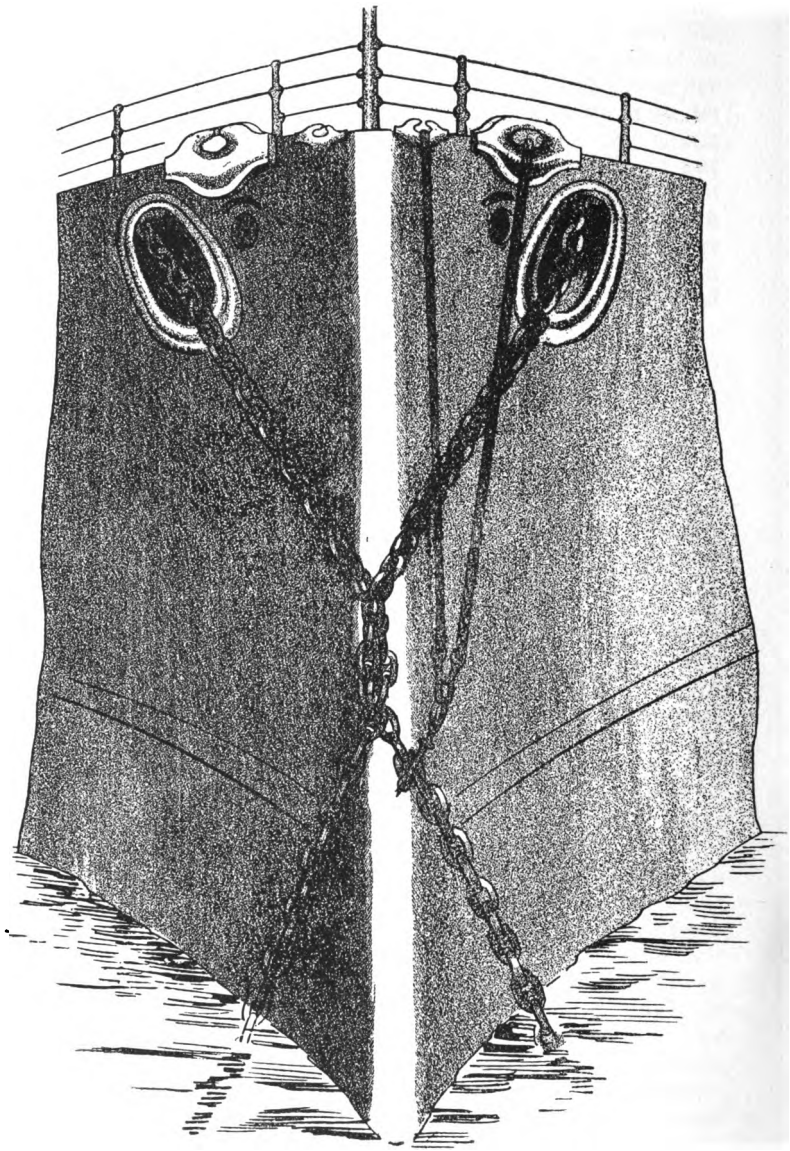
[*To face page* 309.

TO CLEAR HAWSE.



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on the stern cable and the turns taken off the bollards; a wire from after capstan is then shackled on to the cable and the slip knocked off and the cable veered out until the end is just before the slip; then on slip again and unshackle the veering wire and shackle on the large wire from forward; the other end of the large wire is brought to the foremost capstan and then the slip on the stern cable knocked off. Either anchor can now be weighed. When weighing the stern anchor the two parts of the cable are joined up as soon as the wire brings the outboard end in abaft the slip.

To clear Hawse.

If the turns are under water, heave in on the riding cable until above water, and then lash the turns. The clear hawse slip with a hawser rove through it is passed out and put on the non-riding cable below the turns, and both parts of the hawser are hauled well taut.

Veer the non-riding cable, and when slack, unshackle. The end of a hawser is then passed out through the hawse-pipe and taken round the riding cable in the opposite way to the turn which has to be taken out, then pass the end in through the hawse pipe and bend it to the end of the cable.

Heave in on the hawser and pay out the cable, the hawser will bring in the end of the cable after the turn is taken out.

(If there is more than one turn in the cable repeat the operation.)

The two parts of the cable are then shackled together and secured. The hawser rove through the clear hawse slip is eased, and the slip taken off.

Before unmooring with the swivel on, it is advisable to go astern to tauten out the cables and to ensure there being no turns in the cables below the swivel. Should there be turns in the cables, the act of going astern will in all probability clear them; if not, heave the swivel well inboard and dip the end of the non-riding cable round the riding cable a sufficient number of times to clear the turns.

Securing to a Buoy.

Before nearing the buoy, the cable that is intended to shackle on to the buoy is unshackled at the swivel piece or first shackle, and the end led forward to the hawse-pipe. In ships fitted with stockless anchors, the anchor must be removed to the harbour position before the cable can be led through the hawse-pipe to the buoy. A clump

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cathead with roller is fitted on either bow for this purpose, over which the cat pendant is led and hooked or shackled to the ring of the anchor, which is then hove up to the level of the forecastle and secured by a chain rove through the ring; the anchor is then frapped in and secured against the ship's side with chains.

A cutter is got ready for taking the hawser to the buoy, and the boat-rope from the cutter led well forward on the forecastle. When approaching the buoy the cutter is lowered to the water's edge with the blacksmith and his tools in the boat. When sufficiently close, the cutter is slipped and hauled forward by the boat-rope; the spring hook shackled to the catching up rope is passed into the bows of the boat, the wire led aft and sufficient coiled down in the stern sheets to enable the boat to reach the buoy. When close to the buoy the boat-rope is cast off and the cutter pulls to the buoy, paying out the catching up rope as she goes; the two bowmen jump on the buoy, secure the painter to it, then force the spring hook on to the ring. The catching up rope is then hove in by the capstan, and the buoy brought close under the bow. The cable is payed down; a ring rope being bent to it about two or three links up from the end; the ring rope is rove through the ring of the anchor and manned either by the cutter's crew or inboard. The cable is thus hauled into position for the blacksmith to shackle it on. When shackled, the ring rope and spring hook are let go; the length of cable it is decided to ride by is then adjusted and the cable secured inboard.

If through wind, tide, or other causes it is not advisable to send the end of the wire to the buoy by the cutter, the two ends of a grass hawser are passed into her when she is hauled forward, and on the arrival at the buoy one end is rove through the ring and bent to the other; the catching up rope with spring hook is then stopped to the grass line and hauled out to the ring of the buoy by the men on the forecastle.

Securing Head and Stern between two Buoys.

On approaching the harbour flake the catching up rope on the forecastle, on the side towards which the ship is to be turned, and pass the end (with a spring hook on it) into the cutter on that side of the ship. Have central capstan on forecastle, and capstan aft, ready for working.

A 3½-inch wire should be flaked down on the quarter-deck on the opposite side of the ship to the head wire, with the end pointed out through the after fairlead ready to pass into a cutter (the cutter for the stern wire must be

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CATCHING UP ROPE.

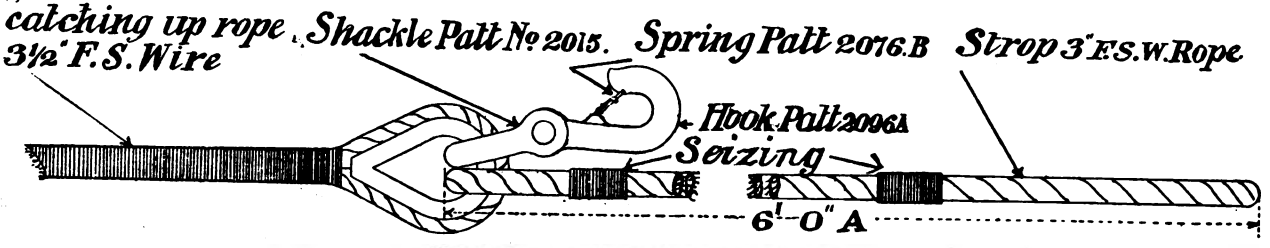
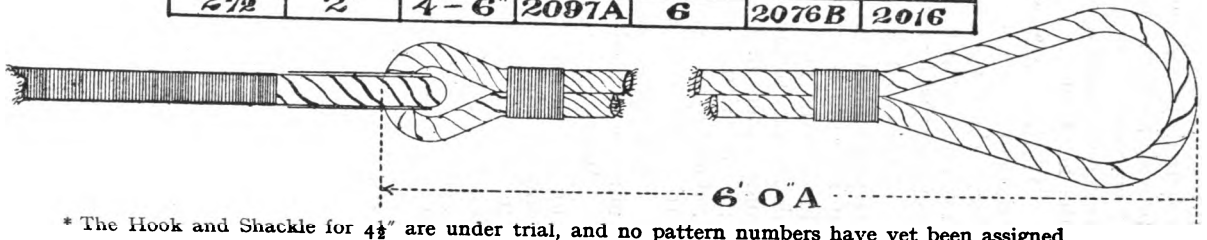


Table of Dimensions.

F.S.W. Rope catching up rope	F.S.W Rope Strop	Length A	Hook Patt no	Hook Test Tons	Spring Patt no	Shackle Patt no
4½"	4"	6'-0"	*	15	2076.B	*
3½"	3"	6'-0"	2096A	12	2076.B	2015
2½"	2"	4'-6"	2097A	6	2076B	2016



* The Hook and Shackle for 4½" are under trial, and no pattern numbers have yet been assigned.

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kept clear after being lowered until the ship is fairly in position, and the probability of the screws not being required to be moved). A Carpenter's stopper must be provided on the quarter-deck, and a larger hawser flaked down ready for finally securing the ship; the bower cable being unshackled at the first shackle ready for securing to the head buoy.

Having both cutters manned and ready for lowering (the cutter for the stern wire having a large shackle in the boat) the ship approaches for a point midway between the two buoys at as large an angle as circumstances and neighbouring ships will permit.

The speed should be so regulated that the ship may be well under command with sufficient way for proper steerage; if the ship is brought up with too much way, the engines have to be put to full speed astern, at a time when by so doing the turning is frustrated and consequently a longer time taken in securing. Therefore (having due regard to the direction and force of the wind) the engines should be reduced to slow speed at from 8 to 10 cables away, and stopped at 2 cables away.

Tide must also be considered, and, if strong, the ship must be secured with her head towards the tidal stream.

When 1½ ships' lengths from the point being steered for, the helm should be put hard over, to swing the head towards the buoy, and when the ship has a decided swing in the desired direction, the way can then be checked by going astern; if the ship has not too much way on, this may be done by going astern with the outer screw only, which would deaden the ship's way and yet not interfere with the rudder continuing to do its work. This will cause the ship to gradually lose her way and consequently gradually stop turning; she can then be manœuvred into position as in turning the ship from rest.

When the ship is sufficiently close to the head buoy, the cutters are slipped, and the one with the head wire pulls to the buoy and secures it. The stern wire must not be passed into the cutter until the ship is almost in position, and no further movement of the engines being probably required. White and red flags are generally used from aft to indicate to the forebridge whether the propellers are clear or foul.

Should there be a long drift for the stern hawser, a second boat will be required to keep the bight up, as it is important not to have a long drift of wire in the water to drag over the bottom.

If wires are already provided on the buoys, the boats would only be required to take a hemp or coir to secure

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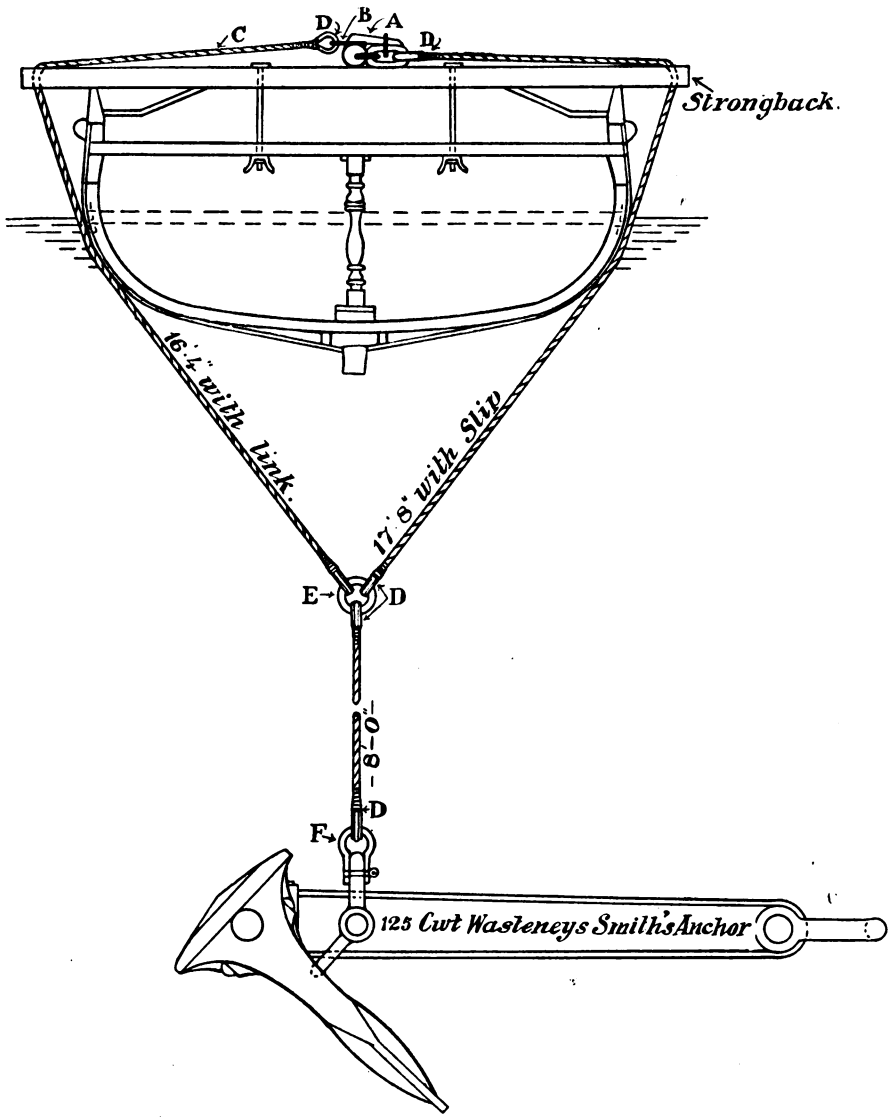
To lay out a Bower or Sheet Anchor.



A	Slip—Patt. D. Yd.	D	Thimbles—Patt. 1920.
B	Link— " "	E	Ring—1¾" × 7".
C	Sling—F.S.W.R. 3½".	F	Shackle—Patt. D. Yd.

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them to the ends of the wires, when they would be hauled on board from the ship.

After the cable is shackled to the buoy, the ship is eased astern and when the large hawser is fast to the buoy and secured aft, the cable is hove in and the ship centred between the buoys and the cable secured.

To lay out a Bower or Sheet Anchor.

The method generally adopted is to lay the anchor out slung under the largest boat in the ship, and for this purpose wire slings are fitted consisting of three legs joined together by a ring. Two of the legs are of equal length and form a span, and are brought up under the boat and over a wooden spreader or strongback and are joined together with a slip.

The third leg is made sufficiently long to reach from the ring of the slings to a little above the water's edge, so as to allow for shackling it on to the balancing band of the anchor.

To get an anchor out, the cat-davit is turned out and the cat-pendant rove as usual, and luffs provided for easing the anchor off the bed. Heave taut the cat-pendant and luffs, then release the tumbler chains, heave in on cat-pendant, and ease away on the luffs till anchor is clear of billboard, then unhook the luffs and lower the anchor to water's edge. The cable is unshackled at the first shackle, and a wire hook rope attached to the end, long lines hung round the cable at intervals; the cable is eased down by these lines and the wire hook rope. As soon as the anchor is nearly down to the water's edge, the boat hauls up alongside it, the short leg of the slings is shackled to the balancing band and the cable hung round the boat with good hangers, and the end kept in the boat for shackling on the wire hawser. The anchor is lowered till the slings have the weight, care being taken that the sling is kept central. The cat-pendant is then unrove and passed into the boat, or a short wire pendant, shackled to the end of cat-pendant, which can be unshackled as soon as the weight of the anchor is on the slings, can be used, in which case the cat-pendant is not sent away, and the end of the short pendant is stopped to the leg of the sling. During the time the anchor is being got out the next largest boat takes in the largest wire hawser in the ship; it is flaked down round the inside of the boat, each flake being stopped to one of the after thwarts to prevent it taking charge. The last flake or last two are stopped round the outside of the boat, and the end kept forward and passed into the boat carrying the anchor and shackled on to the cable. The boat carrying the anchor takes away two luffs, strops,

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compass, boat's bag, axe, and the buoy and buoy-rope, latter of which is bent to the anchor.

All the available cutters, or a steamboat, take the boat with the anchor in tow, the boat with the wire hawser being in tow of her. A kedge anchor is also sent away in one of the cutters.

The boats with the anchor and hawser can either be towed to the required position for letting the anchor go, or can be hauled out by means of the kedge anchor. The hawser of the kedge anchor is rove through a block on the ring of the anchor, so that the kedge being dropped ahead of the position where the bower or sheet anchor is to be dropped, one end of the hawser is made fast to the boat with the anchor and the other end manned on board the ship and the boats hauled out. If the distance is too far for this, the hawser of the kedge anchor has one end secured to the ring of the anchor and the other end brought to the boat with the anchor, and the crews then haul themselves out to the position.

To let the anchor go, the anchor buoy is streamed, the cable and hawser outside the boats eased down and when all clear the slip is knocked off and the anchor drops to the bottom. The men in the boat carrying the wire hawser should be under the thwarts before the anchor is let go in case the wire takes charge. The inboard end of the wire should be secured to the foremost sling bolt.

Another method of getting the cable round the boat is to hook a burton to the head of cat-davit and the other block to a strop round the cable near the hawse-pipe; and by hauling the burton out, the men in the boat can then handle the cable better and can dip the bight of the cable round the bow of the boat, hanging it on each bow with two good hangers and then hang it along on the outside of the boat; the end of the cable will then be aft in the boat ready for shackling on the wire hawser.

After the anchor has been let go the boat with the wire hawser returns to the ship, paying out the wire as she goes.

In laying out a stockless anchor the cable is unshackled abaft the lengthening piece, and the anchor lowered by the mooring pendant (or special pendant if fitted). When the slings round the boat have the weight of the anchor, either the special pendant is lowered into the boat and the end shackled to the big wire hawser, or, if the mooring pendant is used, that is unshackled and the big hawser is shackled to the special wire pendant. Cable is not taken away in the boat.

For modern ships a steel wire pendant is supplied for laying out bower anchors. The pendant should be the

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same size as the largest wire hawser carried by the ship, and fitted with an eye in each end, and a shackle at one end, the same size and pattern as the joining shackle supplied to the ship. The length when fitted should be six fathoms.

To lay out the Anchor in Shallow Water.

The method just described could not be adopted if it was required to lay the anchor out in shallow water, but, if the sling be made in one piece and fitted with an eye in one end and a slip on the other end, so as to fit fairly close up to the boat, and the third leg fitted quite short with either a thimble or a shackle to enable it to travel freely on the sling, several feet can be saved on the depth of the anchor under the boat.

The short leg should be stopped to the upper part of the sling before being placed under the boat in order that it may be accessible for shackling on to the balancing band as the anchor is lowered to the water's edge.

As the cat-pendant is lowered the ring or shackle on the short leg will travel to the lowest point of the sling and thus hang under the centre of the boat.

The weight of the present anchors does not admit of the old method of slinging the anchor between two boats head and stern being adopted, as it would bring the bow of the sternmost boat (even if a launch) with a 6-ton anchor to within 1 foot of the water, and would bring the stern of the other launch, before the anchor was let go, on a level with the water.

If, therefore, it is necessary to lay the anchor out in shallower water than could be done by keeping the anchor close up under the bottom of the launch it must be laid out between two boats; this cannot be done from the cat-davit as the anchor is too close to the ship's side, the main derrick must therefore be used, the anchor is placed under or in the launch, the launch is then dropped under the main derrick, and the shortened catting pendant hooked or shackled to the derrick purchase, and the anchor hove up clear of the water and the slings removed. Two cutters are prepared with a baulk of timber laid across their gunwales, which are built up with strong wooden chocks to withstand the crushing stress, and the baulk of timber securely lashed; the cutters are hauled up one each side of the anchor, and the anchor hung to the baulk of timber from the balancing band by a strop and toggle or slip. Another spar is lashed across the after part of both cutters to which the ring of the anchor is supported; this spar also keeps the cutters from swaying in or out whilst being towed. The end of the wire hawser

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is shackled to the ring of the anchor and the anchor lowered till the baulk of timber has the weight, the shortened catting pendant is then unhooked from the derrick, the wire hawser having been flaked round the inside of the pinnace with a length stopped round the outside during the operation of securing the anchor; the pinnace is towed out astern of the two cutters, a painter being passed in from each bow to the stern of each cutter.

Two cutters carrying a 6-ton anchor in this manner would be immersed about 7 inches.

To weigh a Bower or Sheet Anchor laid out in a Boat.

In most cases the anchor can be weighed by the ship by bringing the wire hawser to the capstan and heaving in; if the ship is anchored it may be necessary to veer her bower cable to allow her to get over the sheet anchor. When the end of the cable comes abaft the slip, the slip is put on and the cable shackled together and the anchor weighed and stowed as usual.

If it is not possible or desirable to weigh it from the ship it can be weighed by the launch in the following manner:—

Place the strongback and slings in the launch as for laying out, to the ring of the slings shackle the upper block of a deck tackle the lower block of which must be shackled to the balancing band (if get-at-able), if not, to the ring of the anchor, by a diver, who must also bend a line on to the end of the cat-pendant, or if the shortened pendant has been used he must shackle the end of the cat-pendant on to it, and in either case the other end of the cat-pendant must be in the launch.

The hauling part of the purchase, which must come from the lower block, is passed over the roller in the stern of the launch, hauled taut, and luff upon luff placed on it, the fall of the luff must be well manned; luffs are also placed on the wire which is taken over the stern roller of the pinnace, these luffs must also be well manned. The anchor is now broken out of the ground, the wire being hauled in until the end of the shackle of cable is up. If the anchor is in very shallow water the cable must be hauled into the pinnace taut from the anchor, otherwise the bight would anchor the launch. When the launch has the weight of the anchor and the wire is in the pinnace, the boats can be towed back to the ship. On arrival, the cat-pendant is rove ready to cat the anchor, and a wire passed out of hawse-pipe and shackled on to the end of the cable. The anchor is then replaced and the cable shackled up.

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To lay out and weigh a Stream Anchor.

A stream anchor can be laid out either hung over the stern of the boat or carried in the boat with the flukes over the stern and the stock lying across the stern sheets on capstan bars.

If the former, and the anchor is an Admiralty pattern, it may be done as follows:—Two capstan bars, specially fitted so that the inner ends fit together and are bolted, are placed over the stern of the boat, the bolted ends being inboard and resting on another bar which is across the boat; a small chain slip is passed over the two bars from the bottom of the boat to prevent them canting with the weight of the anchor. The anchor is hoisted out and lowered till the stock takes across the bars; a wire ring rope from the sling bolt is passed through the ring of the anchor, and set up to its own part with a slip, the wire hawser and reel hoisted out into the bow of the boat, the end of the hawser shackled on to the ring of the anchor, more than sufficient to reach the bottom flaked along the outside of the boat. To let go the anchor, the slips are knocked off and the capstan bars canted, and the anchor then slides off. The buoy-rope is rove through a block on the crown of the anchor, and both parts made fast to the buoy.

If a Martin's or stockless anchor, it is hung over the stern by a wire sling; this may be done by two methods (*see* sketches A and B).

In A the strop would be placed on the anchor on the ship entering port, and it remains on the anchor when it is let go. One end of the strop is shackled to the ring of the anchor and the other end passes over the tongue of a slip shackled to the after sling bolt in the keel of the boat.

Length of strop (when launch is used). { 12 feet 9 inches from bearing of shackle in lug to bearing of thimble.

Length of strop (when pinnace is used). { 11 feet from bearing of shackle in lug to bearing of thimble.

In B the strop is designed so as to be placed in the boat on taking the anchor away and for use with any other anchor carried across the stern. The thimble in the bight of the strop is shackled to the after sling bolt in the keel of the boat, the long end is taken over the stern transom, rove through the ring of the anchor, and the thimble put over the tongue of the slip attached to the short end.

The lengths of the strops are the same as given above for method A.

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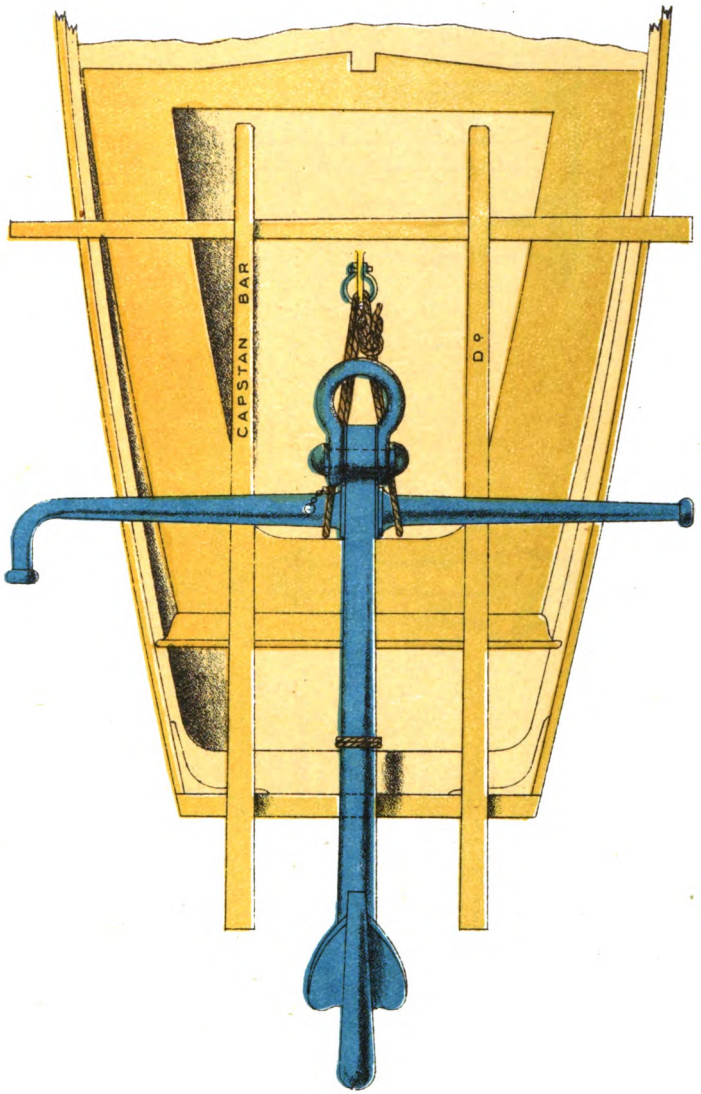
To Lay out an Admiralty Pattern Steam Anchor



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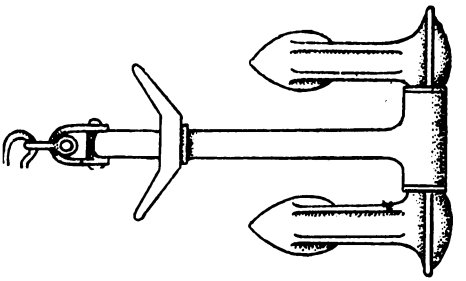
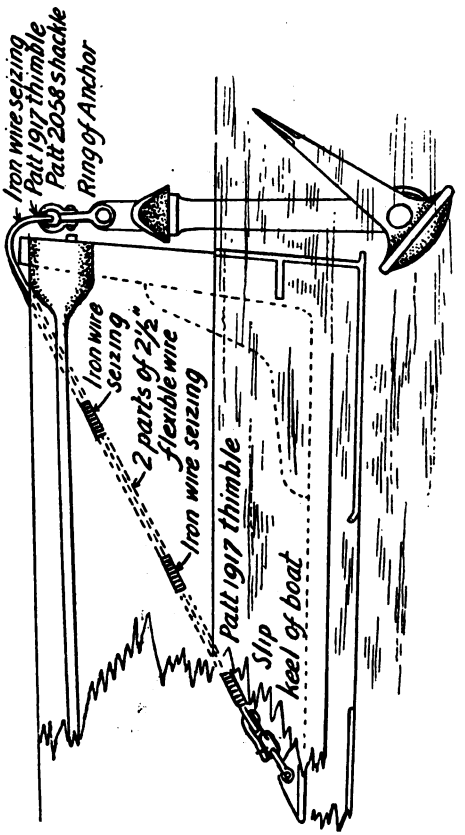
LAYING OUT ANCHOR (STREAM).





A

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LAYING OUT ANCHOR (STREAM).

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In both cases the wire hawser and reel are placed in the boat as before, and the end of the wire shackled to the ring of the anchor, and more than sufficient to reach the bottom stopped round outside the boat. Buoy and buoy-rope provided, and the buoy-rope secured as before.

An Admiralty pattern stream anchor can also be carried in a boat as follows :—

The flukes are over the stern, and the stock lying across the gunwale resting on capstan bars placed as shown in the figure, two lashings being passed, one from the stern ring bolt round the shank to prevent it rolling over, and the other from the ring bolt round both parts of the stock. The hawser and reel hoisted out and placed as before, and the end shackled to the ring of the anchor, and more than sufficient to reach the bottom stopped round on the outside of the boat. Buoy and buoy-rope provided and buoy-rope rove through a block on the crown and both parts secured to the buoy. The anchor is let go by casting off the lashings and lifting the capstan bars, thus allowing the anchor to slide off.

On all occasions before letting go the stream anchor, the depth of water should be taken with the boat's lea and line, and the buoy rope streamed all clear.

The rudder being unshipped, the boat is steered with an oar over the stern, and the masts and sails removed.

The anchor is weighed more easily by the buoy-rope, as being attached to the crown will break the flukes straight out of the ground. One part of the buoy-rope is brought in over the stern and secured, the other part brought in over the stern roller, and either weighed by manning the buoy-rope, or, if necessary, placing a luff or luff upon luff on it ; or it may be weighed by the hawser by bringing the hawser in over the stern roller and using a couple of luffs and a selvagee strop or Carpenter's stopper on the hawser. The fall of the luff can be rove through a snatch block secured to the foremost sling bolt of the boat by a strop sufficiently long to allow the block to come up between the foremost thwarts of the boat.

A wire buoy rope, sufficiently strong to weigh the anchor, attached to a buoy capable of floating it, is sometimes used with a 42-cwt. Martin's anchor, and either shackled to the balancing band or to a strop round the shank of the anchor (this is done to avoid the danger of the buoy-rope fouling the hinges of the flukes if secured to the crown). The anchor is weighed by means of a runner and tackle (with a luff on the hauling part) being brought to the buoy rope by means of a Carpenter's stopper.

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When necessary to fleet in weighing, the buoy-rope is secured round the foremost gun thwart, and runner and purchases overhauled, and Carpenter's stopper brought to again.

If desired to save time, the anchor can be weighed off the ground and the launch hauled to the ship when the wire can be brought to the capstan and the anchor weighed to the water's edge, and then secured to stern of launch.

If the anchor cannot be weighed as above, and is sufficiently near the ship, pass a hawser from the ship to a boat and bend it to the fall of the luff, and bring the inboard end to the capstan. This will weigh the anchor off the bottom, and haul the boat back to the ship at the same time.

Weights and Working Strains.

Weight of anchor, 42 cwt.
Working strain of buoy rope, 4 tons.
Patt. 2,089A block, to lift 4 tons.
Working strain of runner, 4 tons.
Working strain of purchase, 3 tons.
Power, excluding friction, = 24.*
Friction for stern roller, and all sheaves, 50 per cent = 12.

Assuming that 4 tons pull is necessary and 30 men employed in weighing, each man will have to exert $\frac{4 \times 2240}{30 \times 12} = 25$ lbs. (nearly).

Buoy rope, 2-inch wire.

Runner, 2-inch wire (standing part secured to foremost sling bolt).

Tackles, 2½-inch, with internal bound blocks.

Wire strops secured round gun thwart for blocks of tackles to hook to.

Boats :—Launch and cutter, 30 men.

To lay out and weigh a Kedge Anchor.

A kedge anchor is usually hung over the stern of a cutter, and is hoisted out either by the boat's fall or tackle on the davit or by a small derrick fitted for the purpose. The anchor is lowered down to the water and hung over the stern of the boat by a lashing, or a strop

* NOTE.—Runner gives increase of power of 2; purchase gives increase of power of 4 (*i.e.*, 4 parts on moving block); luff on hauling part of purchase (3 parts of moving block) equals 3. Thus 2 × 4 × 3 equals 24.

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and toggle round the shank and under the stock, and secured to the stern ring bolt or to the ring of the after slings. The hawser (a hemp) is coiled down in the stern of the boat, more than sufficient to reach the bottom being stopped on the outside of the boat, and the end then secured to the ring of the anchor with a fisherman's bend. A buoy and buoy-rope is attached to the anchor, the rudder is unshipped and the boat steered with an oar; the masts and sails are removed. The buoy-rope should be rove double, as in the case of the stream anchor, the block secured to the crown, and both ends of the buoy-rope secured to the buoy. The anchor is let go by cutting the lashing or slipping the toggle, the hawser round the boat being first let go. Soundings are taken with the boat's lead and line before letting the anchor go.

To weigh the Anchor.—It is more easily weighed by the buoy-rope, as being attached to the crown will break the flukes straight out of the ground, both parts of the buoy-rope being brought in over the stern and one part secured and the anchor weighed on the other part; but if the kedge is a large one, then proceed as described for weighing the stream anchor.

To Survey Cable.

Cables are surveyed every six months.

On these occasions the chain lockers are cleared, cable is ranged along the deck in shackles, every bolt is driven out, cleaned, white-leaded, and tallowed, the lugs are carefully reamed. Hot tallow is poured into the swivels. Every link is tapped by the blacksmith; should a flaw be found, the length is shifted to bottom of the chain locker until opportunity offers to draw a new one. Loose studs are hardened up or shifted as necessary. Each ship carries spare studs and a mandril for fitting them in. Swivels are also examined and melted tallow poured into the cup, and then the swivel is painted. All slips and spare shackles, capstan, and cable-holders are also examined. The shackles are then joined together, re-marked, shackled to the anchor, and payed down into the chain locker, which is first cleaned and, if necessary, painted.

Since the outboard lengths of cable are most worn, it is usual, after a ship has been in commission for a time, to shift the outboard lengths to the inboard end so that all lengths may wear evenly.

Should a cable part, and the broken link be saved, it is put in a box and sent to the Admiralty. From thence the makers are communicated with. The contractor is known by the initial on the stud.

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Laying out Hawsers.

Wire Hawsers.—Are best laid out by hoisting the hawser and reel into the boat; the reel must be well secured. Wire hawsers being heavy are more manageable on the reel, as the reels are fitted with brakes. The hawser is therefore easily controlled as it is being payed out.

If it is not practicable to hoist the reel out, the hawser must be flaked round the boat close to the sides on top the thwarts, and each flake secured with a good stop to the foremost thwarts to prevent taking charge whilst paying out, each stop being cut in turn; in addition to this, a chain check stopper should be used as follows:—Secure one part of the chain to the after sling bolt, then reeve it up through the stern ring bolt over the hawser and down through the stern ring bolt again, and to this end hook a tackle or good jigger and man it well, then by hauling on or easing the tackle the hawser can be checked or eased.

Hemp Hawsers.—Pass the end into the bow of the boat and make a small coil there; then coil about half the hawser in the stern sheets of the boat, and then pull for the object where the end is to be secured, the ship paying out until there is more than sufficient in the boat to reach the desired object, when start paying out from the boat.

When laying a hawser out against a wind or strong tide, if only pulling boats are available, it is better to take the hawser direct to the object it is to be laid out to, secure the end, and then return to the ship, paying out the hawser from the boat.

Preservation of Wire Hawsers.

Wire hawsers should be periodically taken off their reels and flaked down on tarpaulin and well oiled with wads, after which they should be reeled up again.

Wire hawsers and rigging screws are surveyed and oiled at the same time as the cables are surveyed.

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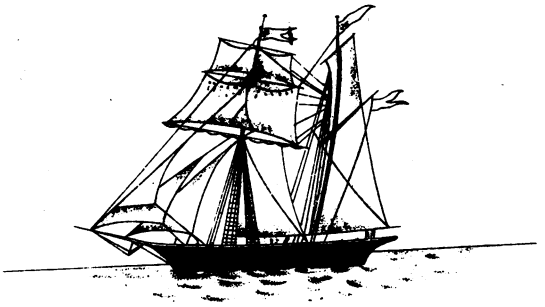
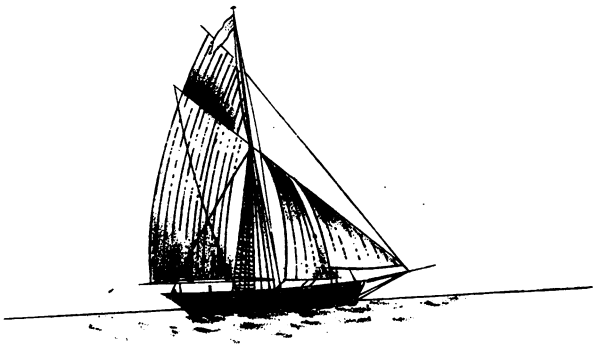
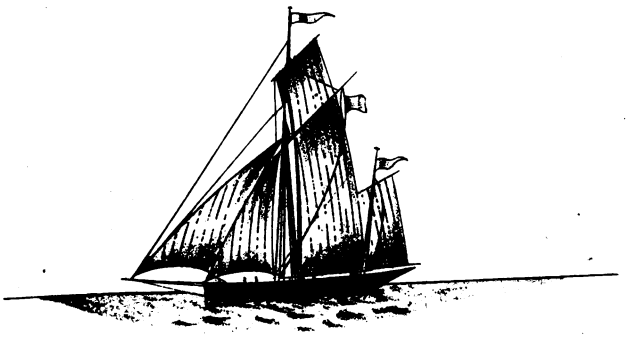


TOPSAIL SCHOONER



CUTTER



KETCH

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1880

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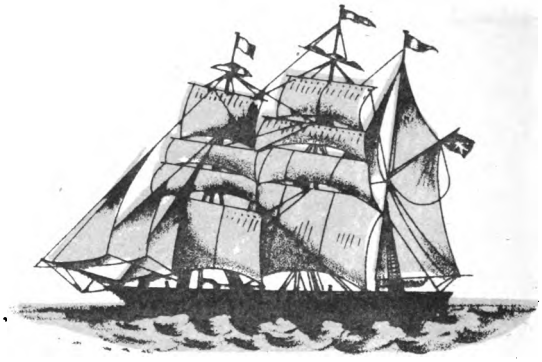
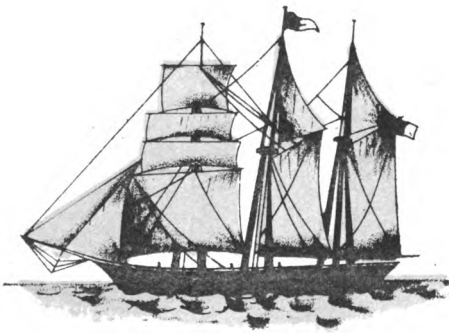
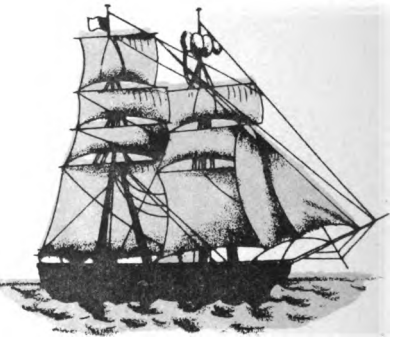


BARK OR BARQUE.

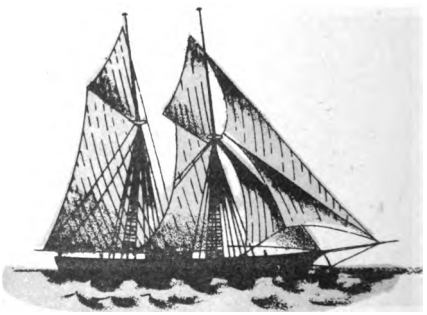


BARQUENTINE



BRIG

BRIGANTINE



FORE & AFT SCHOONER

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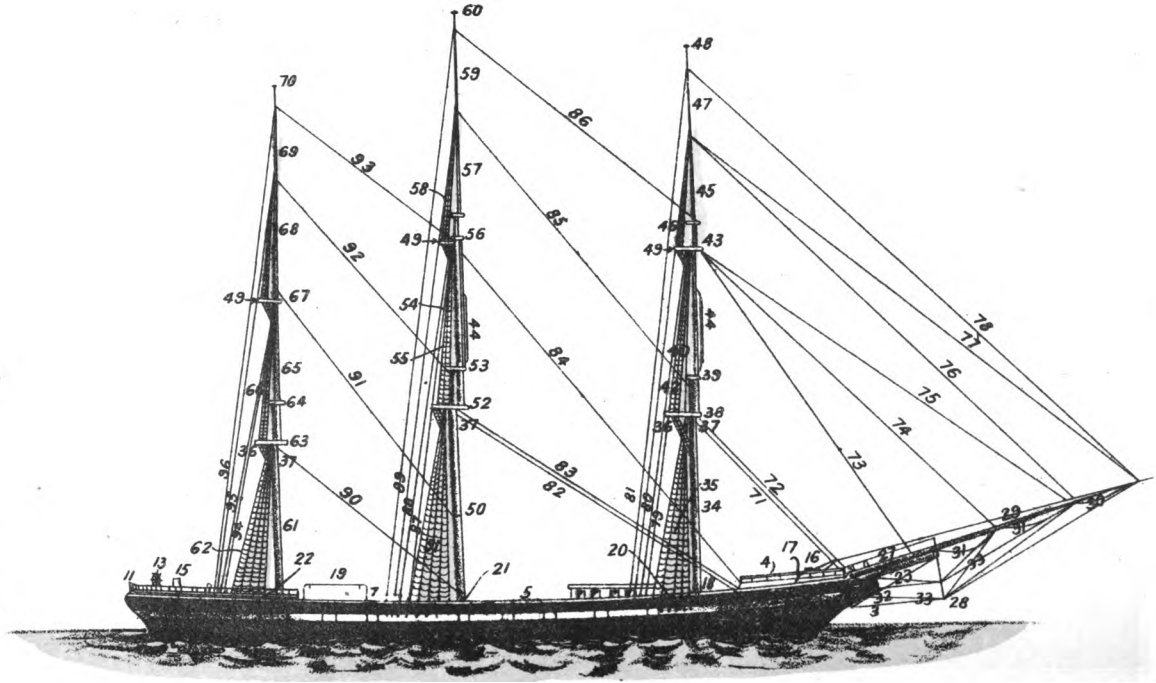
HULL AND STANDING RIGGING OF A SHIP.



THE HULL

1. Bow.
2. Stem.
3. Heads.
4. T'gallant Forecastle.
5. Waist or 'midships.
6. Gangway.
7. Quarter deck.
8. Poop.
9. Quarter.
10. Stern.
11. Taffrail.
12. Counter.
13. Wheel.
14. Rudder or helm.
15. Binnacle.
16. Cat head.
17. Anchor davit.
18. Side light guard.
19. Boat davits.
20. 21. 22. Fore, main, and mizen chains or channels.

THE BOWSPRIT

23. Bowsprit.
24. Gammoning.
25. Bowsprit cap.
26. " shrouds.
27. " horses.
28. Dolphin-striker.
29. Jib-boom.
30. Flying jib-boom.
31. Jib-boom foot ropes.
32. Bobstays.
33. Martingale.

MAST, &c.

34. Fore mast.
35. " rigg'g or shrouds.
36. Futtock shrouds.
37. Lubber holes.

38. Fore top.
39. Fore-mast cap.
40. Fore-top mast.
41. Doublings.
42. Fore-top mast rigging.
43. " " crosstrees.
44. Burtons and pendants.
45. Fore-top-gallant mast.
46. " " rigging.
47. " royal mast.
48. Fore truck.
49. Backstay outriggers.
50. Main mast.
51. " rigging or shrouds.
52. " top.
53. " mast cap.
54. " top mast.
55. " " riggings.
56. " " crosstrees.
57. " top-gallant mast.
58. Main top-gallant rigging.
59. Main royal mast.
60. " truck.
61. Mizen mast.
62. " rigg'g or shroud.
63. " top.
64. " mast cap.
65. " top mast.
66. " " rigging.
67. " " crosstrees.
68. Mizen top-gallant mast.
69. " royal mast.
70. " truck.

STAYS

71. Fore preventer stay.
72. " stay.
73. " top-mast stay.
74. Inner jib stay.
75. Outer
76. Fore-top-gallant stay.
77. Flying jib stay.
78. Fore royal stay.
79. " t'mast b'kstays.
80. " t'gallant "
81. " royal "
82. Main preventer stay.
83. " stay.
84. " top-mast stay.
85. " t'gallant stay.
86. " royal stay.
87. Main t'mast b'kstays.
88. " t'gallant b'kstays.
89. " royal backstay.
90. Mizen stay.
91. " top-mast-stay.
92. " t'gallant stay.
93. " royal stay.
94. " t'mast b'kstays.
95. " t'gallant b'kstays.
96. " royal back-stay.

To face page 323 (3).

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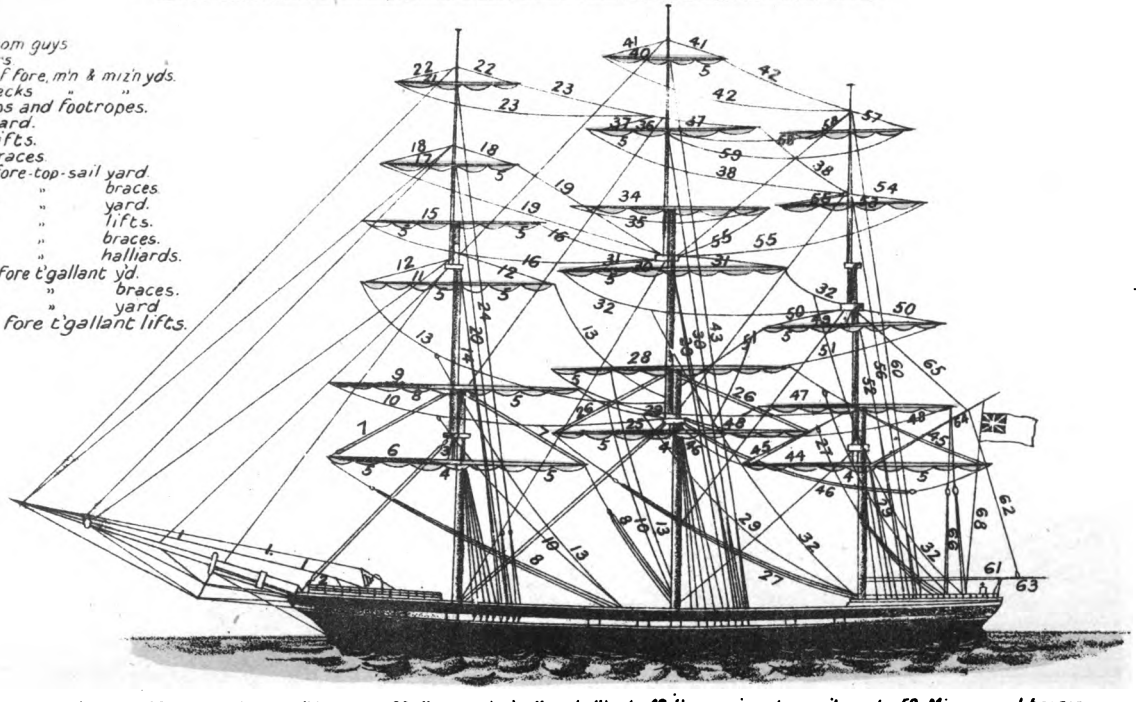
YARDS AND RUNNING RIGGING OF A SHIP.

1. Jib-boom guys
2. Whiskers
3. Slings of fore, m'n & miz'n yds.
4. Goosenecks " "
5. Stirrups and footropes.
6. Fore yard.
7. " lifts.
8. " braces.
9. Lower fore-top-sail yard.
10. " " braces.
11. Upper " yard.
12. " " lifts.
13. " " braces.
14. " " halliards.
15. Lower fore t'gallant yd.
16. " " braces.
17. Upper " yard
18. Upper fore t'gallant lifts.



19. Upper fore t'gallant braces.
20. " " halliards.
21. Royal yard.
22. " lifts.
23. " braces.
24. " halliards.
25. Main yard.
26. " lifts.
27. " braces.
28. Lower main-top-sail yard.
29. Lower main-top-sail braces.
30. Upper " yard.
31. " " lifts
32. " " braces.
33. " " halliards.
34. Lower main t'gallant yard.
35. Lower main t'gallant braces.
36. Upper " yards.
37. " " lifts.
38. " " braces.
39. Upper main t'gallant halliards.
40. Main royal yards.
41. " lifts.
42. " braces.
43. " halliards.
44. Cross-jack yard.
45. " lifts.
46. " braces.
47. Lower mizen top-sail yard.
48. " " braces.
49. Upper mizen top-sail yard.
50. " " lifts.
51. " " braces.
52. Upper miz'n top-sail halliards.
53. Mizen t'gallant yard.
54. " " lifts.
55. " " braces.
56. " " halliards.
57. Mizen royal yard.
58. " lifts.
59. Mizen royal braces.
60. " halliards.
61. Spanker boom.
62. " " topping lift.
63. " sheet.
64. " gaff.
65. " " lift.
66. " vangs
67. Bumpkin.
68. Signal halliards.

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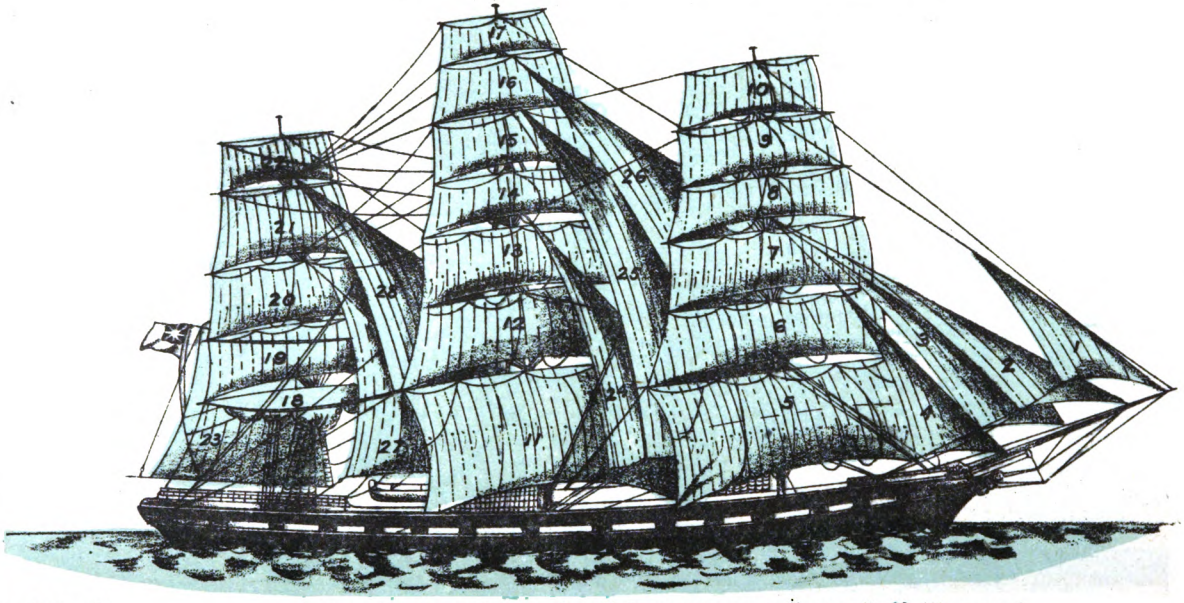
RIGS OF SAILING SHIPS AND VESSELS.

SAILS OF A SHIP RIGGED VESSEL.



1. Flying jib.
2. Outer jib.
3. Inner jib.
4. Fore topmast stay-sail.
5. Fore sail or fore-course.
6. Lower fore top sail.
7. Upper " "
8. Lower fore-top-gallant-sail.
9. Upper "
10. Fore royal.
11. Main-sail, or main course.
12. Lower main top-sail.
13. Upper "
14. Lower main-top-gallant-sail.
15. Upper main-top-gallant-sail.
16. Main royal.
17. Main skysail.
18. Cross-jack (brailed up).
19. Lower mizen top-sail.
20. Upper "
21. Mizen top-gallant-sail.
22. Mizen royal.
23. Spanker, or Driver.
24. Main top-mast stay-sail.
25. Main top-gallant stay-sail.
26. Main royal stay-sail.
27. Mizen top-mast stay-sail.
28. Mizen top-gallant stay-sail.

SHIP IS A VESSEL WITH 3 MASTS AND SQUARE RIGGED ON ALL MASTS.

W. & A.K. GRAHAM LTD LITHO LONDON S.E.

To face page 323 (1).

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CHAPTER IX.

RIGGING.

Before the introduction of steam, ships were entirely dependent on their sails for their motive power. Thus it is evident that their masts, sails, and rigging were of the utmost importance; in fact it was in a great degree owing to the skill of our forefathers in the management of these that many a British victory was won. Now-a-days, as far as the Navy is concerned, sails are practically obsolete, they are, however, still extensively used in commerce; this makes it necessary for every sailor to have a sufficient knowledge of the names of the masts, yards, sails, &c., carried by these vessels, and a thorough knowledge of their different classes in order that they may be easily recognised.

The following illustrations give the names of the sails, spars, and rigging carried by a full rigged ship, also of the different types of sailing craft:—

A Ship is a vessel with three masts, and square rigged on all three.

Bark or Barque.—Is a three-masted vessel, square rigged on the fore and main, and fore and aft rigged on the mizen mast.

Barquentine.—Is a three-masted vessel, square rigged on the foremast and fore and aft rigged on the main and mizen masts.

Brig.—Is a two-masted vessel, square rigged on both masts, and with a boom mainsail.

Brigantine.—Is a two-masted vessel, square rigged on the foremast and fore and aft rigged on the mainmast.

Schooner.—Is a vessel with two masts, fore and aft rigged on both. They are also built carrying from two to five masts.

Topsail Schooner.—Is the same as a schooner, but carrying a square topsail on foremast.

Cutter.—Is a vessel with one mast, and fore and aft rigged.

Yawl.—Is the same as a cutter, but carrying a mizen mast stepped well aft.

Ketch.—Is similar to a yawl with the difference that the mizen mast is stepped further forward and well before the rudder-head.

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Masts.

Masts are now utilised for carrying the means for signalling by flag, lamp, and wireless telegraphy, for support of the helm signal gear, for carrying platforms for range finding and gunfire control, and for supporting the derricks and blocks for working the heavier boats.

Pre-Dreadnought battleships and large cruisers are fitted with two masts, the foremast standing near the fore-end of the fore boiler room, and the mainmast just abaft the end of the engine rooms. The majority of the ships of the Dreadnought and later types carry two masts, but in the latest ships the disposition of the main armament permits of only one being fitted. The position of the mast or masts in the fore and aft direction is also determined by the disposition of the main armament. The masts in these ships (as in "Lord Nelson" and "Agamemnon") are of the tripod type, that is, each consists of a vertical lower mast which is supported in position by two inclined steel struts instead of by rigging. These struts have their middle line planes vertical, but standing at an angle of 40 degrees with the middle line plane of the ship. In these masts access to the platform at the head of the lower masts is obtained by ladders fitted inside the mast and inside the two struts, doors being fitted just above the heels.

Smaller ships, such as second and third class cruisers, are fitted with two masts, but scouts and torpedo craft carry one mast only and that a comparatively light one.

The main truck in a large ship stands about 180 to 190 feet above water. In smaller ships the height is of course less, and the masts are given a rake instead of being vertical as in the largest ships.

Masts, as now fitted to a large ship, consist of a lower mast, topmast, and topgallant mast. The last carries the wireless telegraphy yard and is also in some ships fitted with a pole for taking the Admiral's flag.

In the later battleships and large cruisers there are two yards on the foremast for signalling purposes, and one small yard on each mast just below the truck to carry the wireless gear. In the latest ships, which have only one mast, there are four yards, three for signalling by flags and one for wireless gear. Older battleships and large cruisers carry two yards on each mast, with a gaff on the main-top-gallant-mast for the wireless telegraphy gear. Second and third-class cruisers carry a yard on each mast in addition to the small wireless telegraphy yard.

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In the oldest battleships now in commission each mast also carries a derrick, that on the mainmast being a large steel derrick for hoisting the largest boats in and out, these boats being stowed in crutches on each side of the middle line of the ship and near the mainmast. The derrick on the foremast is lighter, and of wood, and is used for hoisting lighter boats, and also for coaling. In some classes of ships the derrick on the foremast is replaced by two derricks, one on each side of the middle line, and with the heels fitting on the boat deck.

In ships of the "Dreadnought" and later types a steel derrick for working the boats is fitted on one mast, and four stump masts, each fitted with a wooden derrick, are used for coaling and other purposes.

The lower masts are constructed of steel, the topmasts of Oregon pine or Riga hand masts, and the topgallant masts and yards of pitch pine or Riga hand masts. Steel lower yards have been tried, but have not been generally adopted.

The diameter of the lower mast in ships fitted with tripod mast is 42 inches, the struts being 36 inches in diameter. In battleships and large cruisers fitted with ordinary masts the diameter of lower masts, from heel to top platform, is from 30 to 36 inches, tapering from the platform to the head to 24 inches diameter. In smaller ships the diameter is reduced, being from 16 to 18 inches diameter in gunboats. The former dimension is the lowest limit at which steel masts can be constructed, so that masts below this diameter are constructed of wood.

The section of an ordinary (not tripod) lower mast is given in Fig. 1.

Section of Mast.

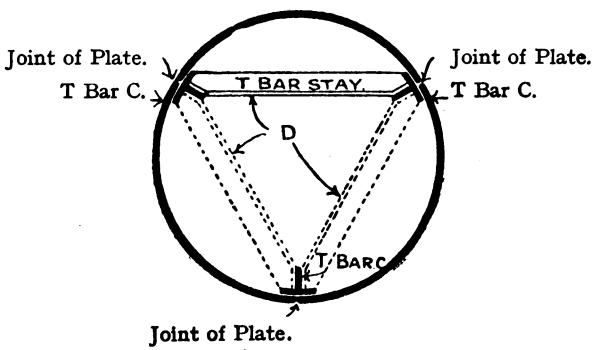

Fig. 1.

Three plates of equal breadth are rolled to circular form and when placed in position, edge to edge, form a circle.

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The contiguous edges of the plates are each riveted to the flange of a **T** bar C, three **T** bars being required for these connections. The plates are worked in lengths of from 20 to 24 feet, the "butts" or "joints" of the plates being connected by butt straps worked on the inside of the plates between the edges of the **T** bars. These butts or joints, being weaker than the plates themselves against certain forces, they are carefully "shifted," *i.e.*, the butts or joints of contiguous plates are placed as far as possible from each other. In plates 24 feet long the butts of contiguous plates would be at least 8 feet apart. The butt straps are fastened with four rows of rivets on each side of the butt.

The **T** bars are worked in the longest lengths procurable, the butts of the bars being connected by two angles fitting into the bosoms of the **T** bars. To stiffen the mast transversely the **T** bars are connected across in pairs by angle or **T** bars (D in Fig. 1). These cross stays are about 3 feet apart so that each pair of bars are cross connected every 9 feet (*see* D in Fig. 2).

Doubling plates are worked on the outside of the mast where extra stiffness is required, such as at the wedging (B in Fig. 2) at the heel of the derrick and in wake of the eye-plates for the blocks for purchase and topping lift.

In the case of a tripod mast, the lower mast, *i.e.*, the vertical portion of the tripod, is constructed of four plates of equal breadth connected at the edges by **T** bars as for an ordinary lower mast. There will of course be four **T** bars in this case. The mast is stiffened by **T** bar rings worked around the inside of the mast between the vertical **T** bars and about 6 feet apart. These **T** bar rings are riveted to the plating and also to the **T** bars and take the place of the cross stays (D in Fig. 1) of the ordinary lower masts.

The struts to the mast are constructed similarly to an ordinary mast, except that the horizontal stays run around the mast as in the tripod lower mast. The struts are well connected at the top to the lower mast and to the landing platform, fitted just above the junction of the mast and the struts.

The plates in a lower mast as fitted in a battleship or large cruiser are from $\frac{3}{8}$ to $\frac{1}{2}$ an inch thick; those in smaller masts are from $\frac{1}{4}$ to $\frac{3}{8}$ of an inch thick, two plates completing the circular form instead of four. The method of connection is the same in either case.

The heel of a lower mast is usually stepped on the middle deck which is, if necessary, stiffened by pillars from underneath to support the weight.

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[*To face page* 326.

STEEL MAST.

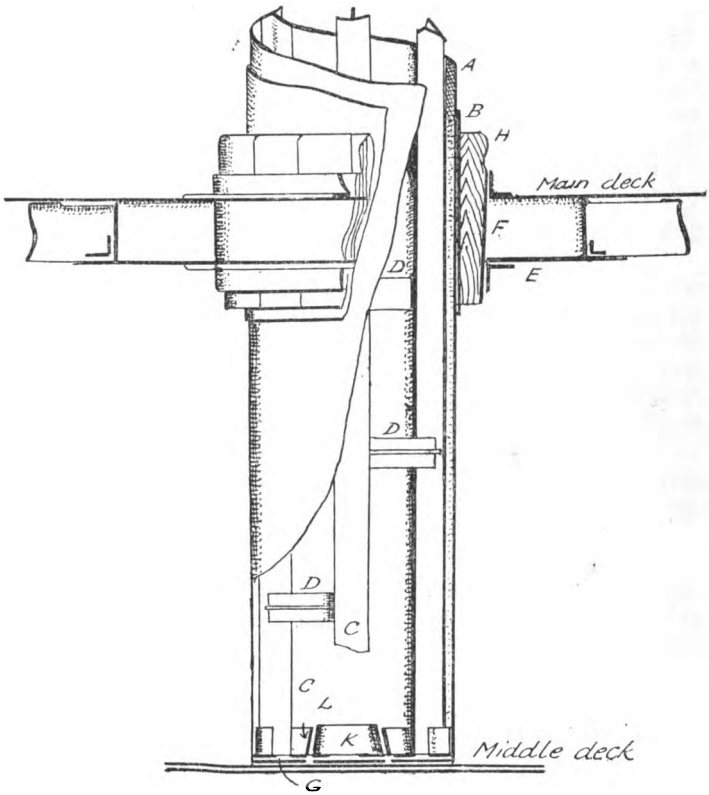

Fig. 2.

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A circular plate G is fitted across the heel and secured to it by an angle running round inside the heel of the mast; a hole about 10 inches square is cut out of this plate, and an angle is fitted round it on the inside (L in Fig. 2), an angle square (K in Fig. 2) of about the same dimensions and slightly tapered is secured to the middle deck, and on it fits the angle on the heel of the mast. The portion K on the deck is the mast "step."

The mast is also "wedged" at at least two decks, generally the main and the upper. At these decks a strong structure of plate (E) with angle bars is fitted under the beams and connected to them; this structure carries a mast tube (F) which is concentric with the mast and from 8 to 12 inches greater diameter. The space between the mast and the tube is filled in with wooden wedges (H) which are driven tightly home. This is termed the "wedging" and keeps the mast in the required position.

The distance from the step to the top of the upper wedging is called "housing."

In the case of tripod masts no wedges are fitted at the decks through which the masts or struts pass. The plating of the deck is increased in thickness and the plating of the mast is connected to the plating of the deck by an angle ring in two parts, well strapped together at each deck, riveted to the deck and mast or strut. Similarly an angle ring is fitted round the heel of the mast.

In destroyers and torpedo boats the mast does not pass through the deck, but is fitted in a tabernacle made of steel and of similar shape to those in boats.

Rigging of Lower Mast.—When a ship is rolling or pitching large forces act on the mast due to the overhanging weight and to the accelerative motion of the ship; the latter in quick-moving vessels being of great importance.

In starting and stopping, especially when stopping suddenly, as in the case of a collision, forces act on the mast in a fore and aft direction.

During the operation of lifting, traversing, or lowering a boat with the derrick, large forces also act on the mast.

To assist the mast in withstanding the various forces brought on it, the standing rigging is fitted. (*See* Fig. 3.)

When rolling, or with the derrick over the side supporting a boat, the forces on the mast are all transverse, that is across the ship. The shrouds are fitted to support the mast against these forces; there are generally three or four shrouds on each side, and in large ships they are

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of 4½-inch steel wire rope, secured at the lower ends abreast the mast and if possible to the edges of the deck, it being most important that the "spread" transversely should be the greatest possible. In ships in which the waist guns on the upper deck fire directly fore and aft it is impossible to secure the lower ends of the shrouds to the edge of the deck, and therefore they have to be secured further inboard, which reduces their effect; it is partly on this account that in some of the most recent ships two struts have been fitted instead of the shrouds, forming a tripod mast.

To assist the mast when the forces brought to bear on it act in a fore and aft direction, stays which lie as nearly as practicable in fore and aft lines are fitted. The direction of the forces alters with the pitching of the ship, sometimes being in a direction from forward to aft, and sometimes from aft to forward; as wire stays or shrouds can only support the mast by stretching, it is necessary to fit stays both before and abaft the mast.

The foremast (Fig. 4) is provided on the fore side with a forestay leading from the head of the mast to the stem of the ship, and in the event of this stay having to be eased up to permit of the bow guns firing ahead, two preventer or fighting stays are fitted, which are set up to the deck abaft the arc of training of the forward guns; and two preventer backstays or shrouds are fitted on each side abaft the mast.

The mainmast (Fig. 3) is fitted on the fore side with (generally) two mainstays which lead from the lower mast head to well forward in a nearly fore and aft line close to the funnels. In some ships with the funnels well forward only one mainstay is fitted, secured at the middle line. Preventer backstays or shrouds are fitted on the aft side of the mast, generally four. In a large ship all these stays are of 4½-inch steel wire rope; in smaller ships the sizes are less, being about 3-inch in a third class cruiser.

Steel hoops or bands are secured round the lower mast head, these have eyes forged in them, and to the eyes are shackled the upper end of the standing rigging. (*See* Figs. 5 and 6.)

The lower ends are secured to a bottle-screw and slip, the slip being secured to a shackle carried by an eye-plate at the deck edge. The rigging is set up by means of the bottle-screw, and when set up the latter is locked by means

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STANDING RIGGING TO MAIN MAST.

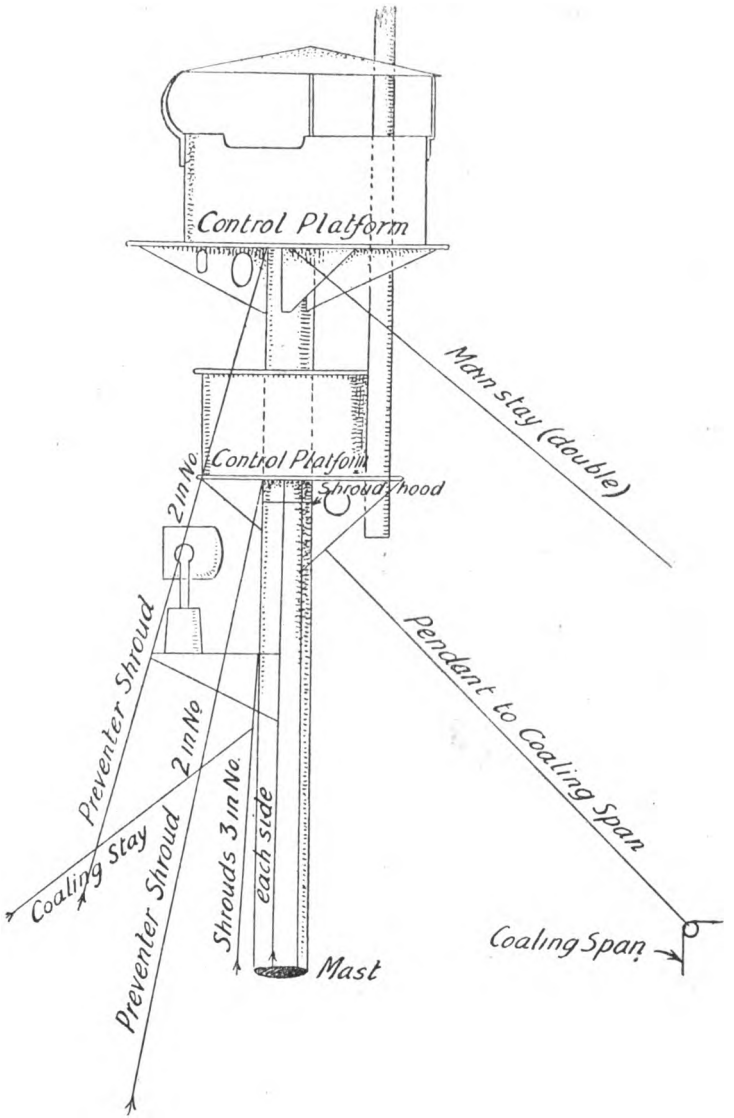

Fig. 3.

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FORE MAST STANDING RIGGING.

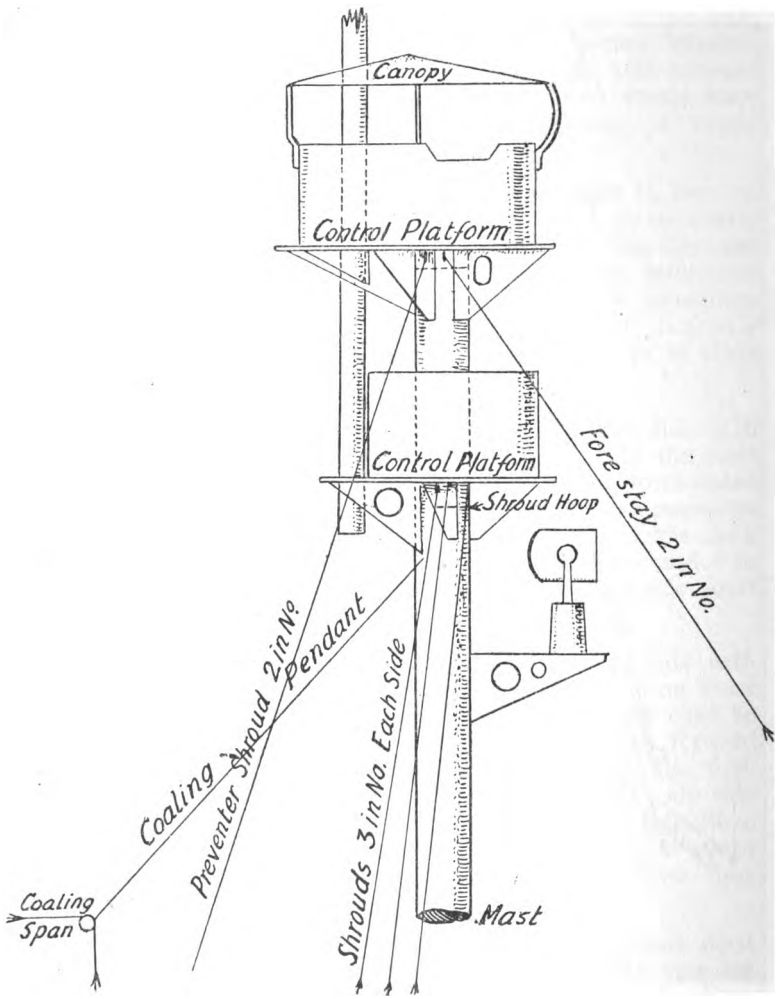

Fig. 4.

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HALF PLANS.

Shroud Hoop Stay Hoop.

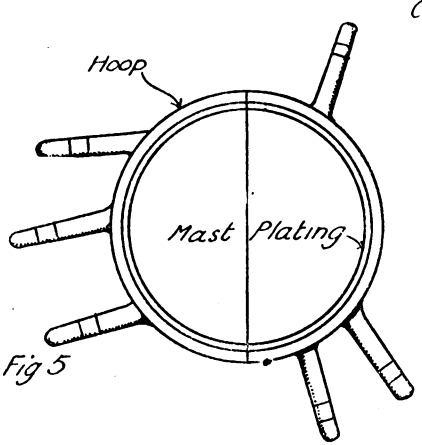


Fig 5

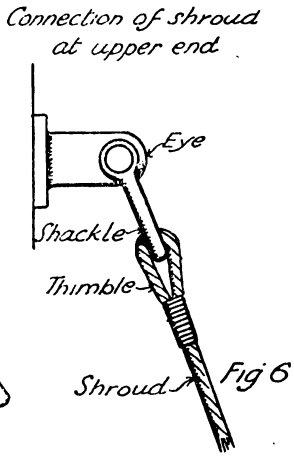
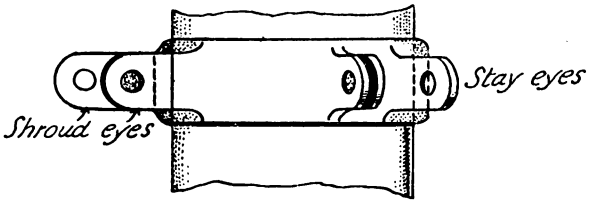


Fig 6



Elevation.

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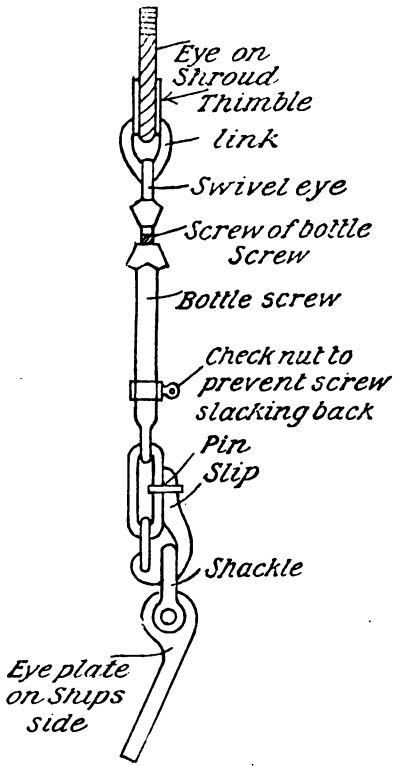
of a check piece which prevents the bottle-screw from easing back. The whole is covered with painted canvas.



Connection of Shroud to Ship's side.

Fig. 7.

Ratlines are fitted to the shrouds, but access to the fire control and searchlight platforms can be obtained by hand-holds on the outside of the mast, about 12 inches apart; they are of the "dropped" pattern to prevent the feet slipping over them. (*See* Fig. 9.) In tripod masts access is obtained by doors in the heel of the central mast, and ladders on the inside.

The Topmast is made of wood and in large ships is capable of being struck, but in small ships it is generally stepped into the head of the lower mast and cannot be struck. The whole mast is then termed a "pole mast." A striking topmast is generally fitted on the fore side of the lower mast, but in many cases it is on the fore side of the mainmast and on the aft side of the foremast.

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In large ships the length of the topmast is from 50 to 60 feet from heel to head. The heel is usually square, the corners being "chamfered" away, this shape being retained for about 8 feet; above this it is circular and at the head is about 8 inches in diameter. There are generally one or two "stops" between the head and the heel, *i.e.*, the diameter is suddenly reduced by from 1 to 2 inches. A copper or steel funnel is fitted over the "stop." These funnels are for taking the topmast rigging. Just under the funnels the topmast is slotted through and a sheave is fitted, through which are rove the "girdlines" or halliards, which come down to the deck and are used for lifting gear and various purposes. Before the introduction of the topgallant masts for wireless telegraphy two "stops" were fitted to the topmast, and the length of the mast above the upper stop was termed the "pole." With a topgallant mast only one stop is fitted.

A slot is cut diagonally across the heel of the topmast into which fits a vertical metal sheave, through which the top rope reeves for fidding or striking the topmast.

In some of the larger topmasts a second sheave about 8 feet above the lower one is fitted and running in the opposite direction, and through this is rove the preventer top rope. The mast is kept in position at the heel by the structure of the lower platform which fits closely against it on three sides, and at the upper platform it passes through a hoop lined with wood or leather into which it fits fairly closely. This hoop turns on trunnions fitted across the ship, and bearing on the structure of the upper platform. The weight of the mast is taken by a steel fid which reeves through the fid-hole in the heel of the topmast, and bears on each side on the lower platform structure. In addition to the fid there is a pawl on the lower platform structure, which takes against a toothed rack on the topmast; this toothed rack is about 6 to 8 feet long and is fitted on the side of the mast away from the lower mast. (*See* Fig. 9.)

Topmast Rigging.—The standing rigging consists of—shrouds, stays, and backstays.

The shrouds, like those of the lower mast, take the transverse forces, and the stays and backstays the fore and aft forces.

With no topgallant mast fitted the rigging is as shown in Fig. 8. The shrouds lead from the lower stop to the upper control platform, and are secured there by slips and bottle screws to eye-plates; there are two on each side. The backstays lead from the lower funnel to the control

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TOPMAST RIGGING.

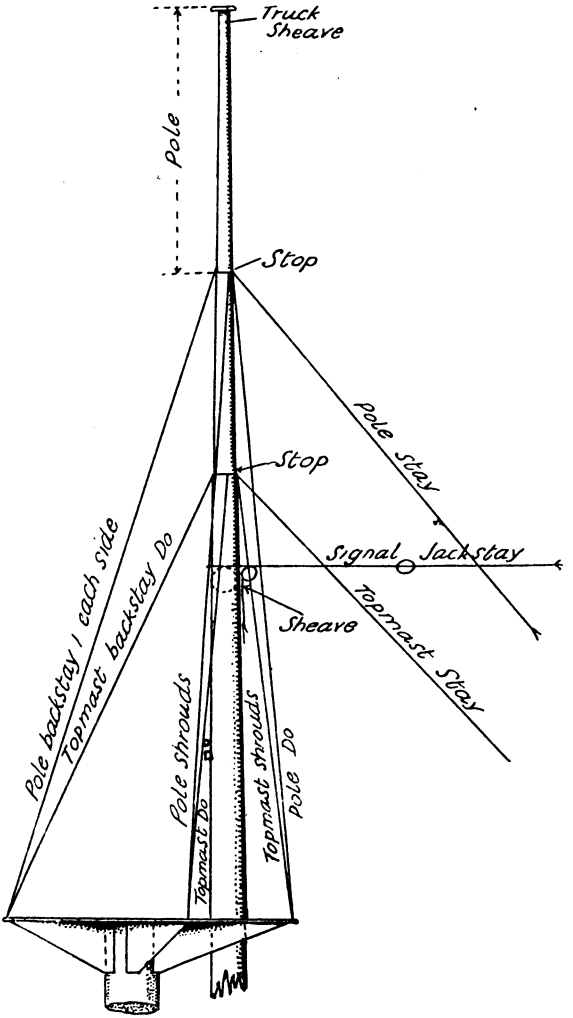

Fig. 8.

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STRIKING TOPMAST.

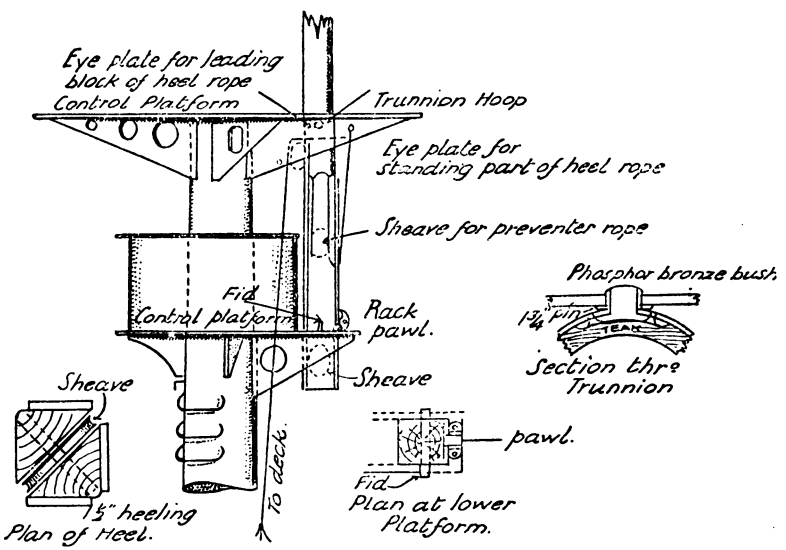

Fig. 9.

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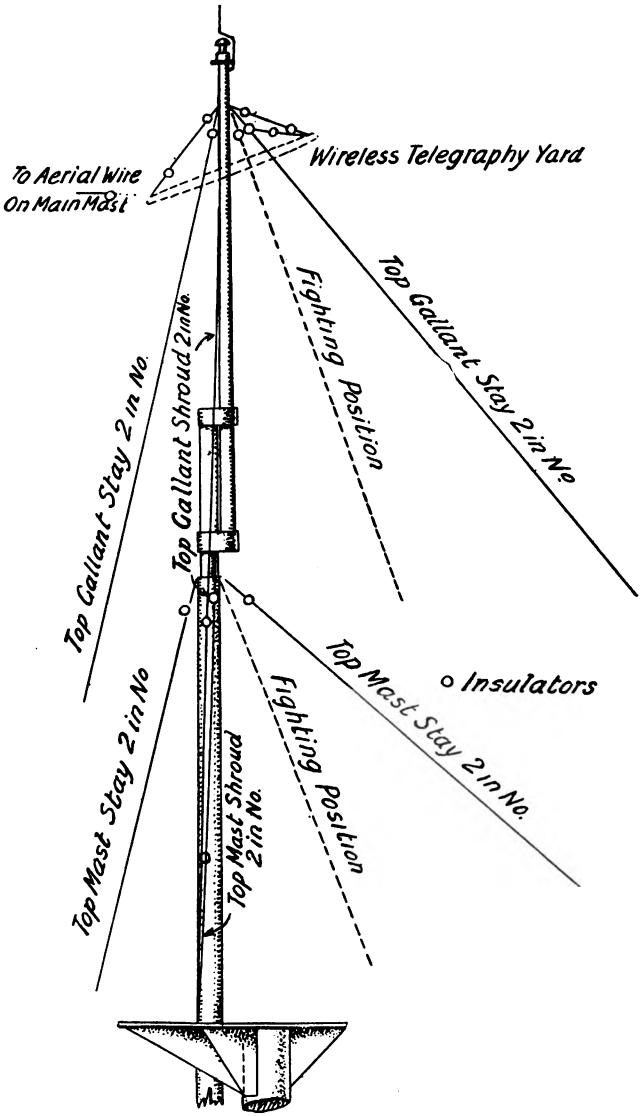
To Aerial Wire
On Main Mast
Wireless Telegraphy Yard
Top Gallant Stay 2 in No.
Fighting Position
Top Gallant Shroud 2 in No.
Top Gallant Stay 2 in No.
Insulators
Top Mast Stay 2 in No.
Fighting Position
Top Mast Stay 2 in No.
Top Mast Shroud 2 in No.

Fig. 10.

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platform—in some cases the backstays lead to the deck—and are secured in the same way as the shrouds; the stays lead to the deck.

Similar rigging is fitted to bear on the upper stop and termed pole shrouds, pole stays, and pole backstays. (*See* Fig. 8.) The upper ends are fitted over the funnel with eye splices. They are of steel wire rope from 2½-inch to 1½-inch.

When the topmast is struck the eyes of the rigging bring up against the upper platform, and the slack is gathered into the control platform.

In ships with no control platforms the shrouds, &c., lead to the deck.

At the pole head in ships with no topgallant masts a wooden lignum vitæ truck is fitted with three small metal sheaves for signal halliards; access to the truck is obtained by a Jacob's ladder.

In ships fitted with topgallant masts there is only one stop or funnel on the topmast, which in this case is higher up the mast, and the pole rigging is dispensed with. (*See* Fig. 10.)

All rigging within 40 feet of the topgallant mast head is fitted with "insulators."

A lightning conductor is fitted to the topmast, consisting of a copper strip running up and down the mast and terminating in a point at the head; at the heel it bears against a spring knob which is in metallic connection with the lower mast. Electricity is thus conducted away to the ship and thence to the water.

Topgallant Mast.—This spar is now being fitted in ships for the purpose of supporting the aerial gear for wireless telegraphy. It is from 30 to 36 feet long and tapering in diameter from 8 inches at the heel to 6 inches at the head. It is fixed to the topmast by two "Spectacle" bands (A and B, Fig. 11), the heel of the mast being made square and fitting into a square hole in the lower spectacle band. The head of the mast is fitted with a truck and also a gallows for supporting a flashing lamp. About 4 feet below the head a yard about 20 feet long is fitted to take the aerial wires; this yard is fitted with lifts and braces, which shackle to eyes on a band round the yard-arms.

A stop or funnel is fitted on the mast just below the truck, for the rigging which leads down either to the control platform or the deck, and consists of two stays and two backstays.

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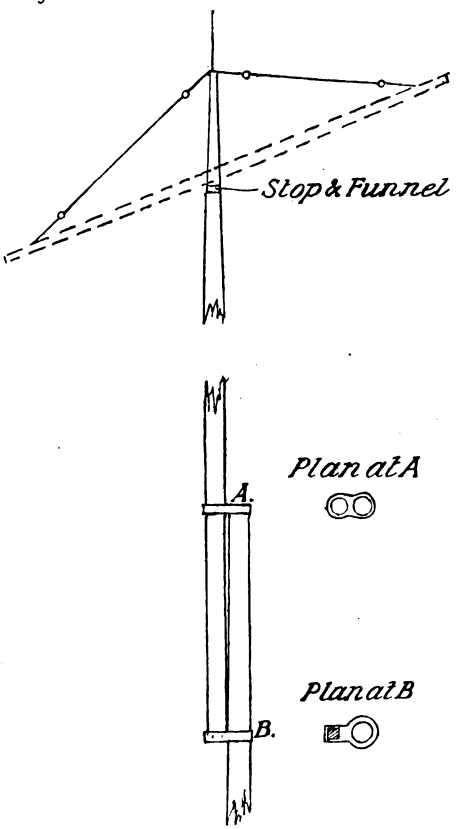
The topgallant mast cannot be struck with the topmast fidded; if necessary to strike or lower the topgallant mast the topmast must first be struck and the topgallant mast then raised by a jury mast or a small pair of sheers. In a few ships the topgallant mast has been fitted to the topmast in a similar manner to that in which the topmast is fitted to the lower mast. It can then be struck independently.



Topgallant Mast and Yard for Wireless Telegraphy.

Fig. 11.

In the latest battleships a pole mast is fitted to the topgallant mast, and is supported by it in a similar manner to that shown in Figure 11. This pole is 16 feet long, and carries the Admiral's flag and the flashing lamp.

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RUNNING RIGGING, &c.

Topmast Gantlines or Halliards have already been referred to. They reeve from deck, through sheaves just below the lower stops or funnels on the topmast, and lead down on deck. They are of 3-inch hemp, hawser laid, and are used for lifting weights up the mast and general purposes.

Pole Gantlines reeve from deck through sheaves just below the upper stop or funnel and lead down on deck. They are of $2\frac{1}{2}$-inch hemp.

Coaling Spans.—These run between the two masts and sometimes from the mainmast aft. They are of steel wire rope. A steel wire pendant is shackled to an eye-plate at the lower mast head with a block at the lower end; the coaling span reeves through these blocks and is set up on deck with a purchase. Whips are suspended from the span for coaling purposes.

Signal Jackstay is of $1\frac{3}{4}$-inch flexible steel wire rope. It reeves through blocks shackled to eyes on a band on the topmast and is set up on deck with slips and bottle screws; used for supporting the blocks of signal halliards.

Clothes Lines are of $1\frac{1}{2}$-inch flexible steel wire rope and reeve in some ships through blocks on the after shroud of foremast and the foremost shroud on mainmast, one end being set up with a purchase and the other end secured on deck. There are four on each side. In other ships they are fitted on the forecastle and lead from forward through a thimble on a wire jackstay up and down the fore rigging and set up on deck with tackles.

Hammock Gantlines.—In some cases a jackstay is fitted up and down the lower mast and set up on deck, with thimbles seized into it. The gantlines reeve from deck through the jackstay thimble and set up on the forecastle with a purchase; if they are fitted to the mainmast as well, they lead aft and are set up on the quarter-deck. In cases where no jackstays are fitted the gantlines reeve through blocks which are shackled to eye-plates on the lower platform.

Dressing Lines consist of three separate jackstays which lead from the foremost awning stanchion to the upper topmast stop, from the upper topmast stop on foremast to upper topmast stop on mainmast, and from the upper topmast stop on mainmast to the after awning stanchion. They are made of 1-inch flexible steel wire rope and are fitted with a swivel at either end.

The fore jackstay has a swivel at each end, the foremost, one being about 2 feet abaft the block on the foremost

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awning stanchion, the other being at the upper end just before a block on the topmast stop. At the foremost end a short steel wire rope with a rope tailing is connected to the other side of the swivel, reeves through the block, and is set up by a jigger on deck. At the upper end a whip is secured to the other side of the swivel on the end of the jackstay, and reeves through the block on the mast down to the deck and thence through a leading block, and has a rope tailing. The remaining two jackstays are fitted and reeve in a similar manner, except that the one between the two masts is fitted with a single whip on both ends.

Downhauls are fitted and secured to the centre of each jackstay, and are made of hemp.

The whips are of 1-inch flexible steel wire rope with hemp tailings.

A set of flags for dressing ships is kept on the dressing lines.

Signal Halliards are of 1 or 1¼ inch white signal halliard line. They reeve through metal blocks or sheaves and are fitted at each end with clips for bending on the flags.

They lead to the yards, trucks, and signal jackstay.

Signal Yards.

Two signal yards are carried on the foremast,* the lower one being slung from the lower mast and the upper one from the topmast. They are generally made of Riga hand masts, are circular in section, and taper from the bunt or middle of the yard to the yard-arms.

In some cases they are made octagonal at the bunt and circular in section towards the yard-arms.

A stop is formed about 4 feet from each end, the portion outside the stop being termed the "yard-arm." The lower yard is about 65 feet long, the diameter at the bunt being about 18 inches and 7 inches at the yard-arm. The upper yard (or commonly called foretopsail yard) is about 40 feet long with a diameter at the bunt of 9 inches, and 6 inches at the yard-arm.

The lower yard is slung by a chain sling from an eye-plate on the lower mast, and is secured to the yard by a shackle connected to an eye formed on a steel band round the yard. A steel wire rope passed round the mast and secured to eyes on the band on the yard keeps the yard home against the mast. This steel wire rope is termed a "parrel," and is of 1½-inch flexible steel wire.

* In the latest ships with one mast only three signal yards are carried in addition to the wireless yard.

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LOWER SIGNAL YARD AND RIGGING.

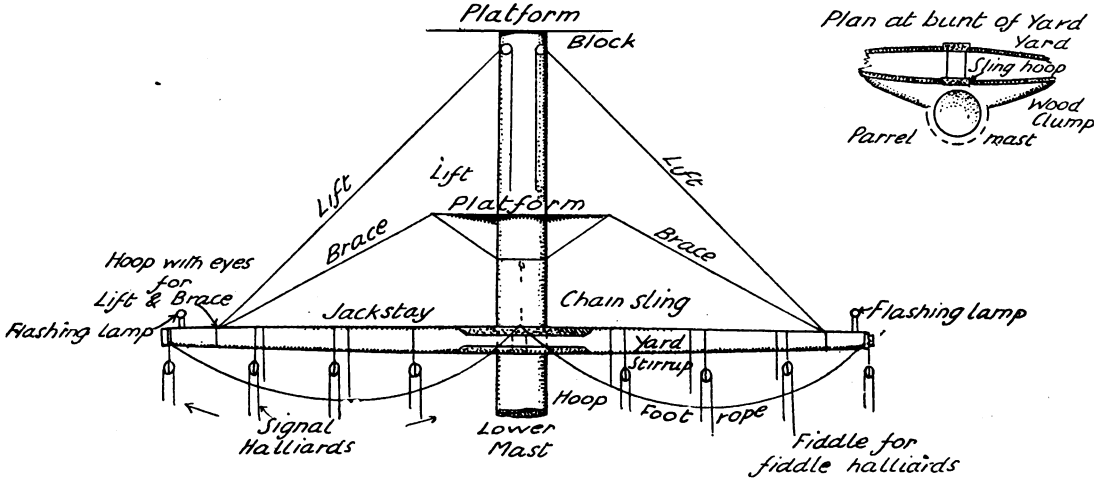

Fig. 12.

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In cases where the yard is octagonal at the bunt, a clump of wood is fitted on its side which fits partly round the mast, and the parrel passing round the mast completes the connection. (*See* Fig. 12.)

The lifts (2-inch flexible steel wire) reeve from the control platform (where they are set up with slips and screws) through blocks secured to an eye-plate at the lower masthead and shackled to an eye on the band at yard-arm.

The braces (2-inch flexible steel wire) reeve direct from control platform to eyes on the same band as the lifts.

A jackstay (1¼-inch F.S.W.) of 1¼-inch steel wire rope runs along the top of the yard from yard-arm to yard-arm, and is kept in place by reeving through eyes which are screwed into the yard.

Foot-ropes (1½-inch F.S.W.) are fitted, which extend from the bunt to each yard-arm, being hooked with calliper hooks and moused, to bolt at extreme end of yard-arms, and supported by three stirrups (1½-inch F.S.W.) on each side, the inner ends having a thimble turned in, are set up and then seized to saddle chock to keep it in place.

Four metal swivel blocks are secured to the yard on each side by wire strops and are for the signal halliards to reeve through.

The upper signal yard is similarly rigged except that the yard is slung by a steel wire sling from the topmast stop, there are only two blocks for signal halliards on each side, the lifts and braces are half-an-inch smaller wire, the lifts are set up with lanyards instead of slips and screws, and the bunt end of foot-rope is fitted with a cut splice which fits over the sling bolt of the yard.

To Strike the Topmast.—The topmast rope is rove from deck through a block on the lower side of the upper platform, through the sheave at the heel of the topmast, and secured to an eye-plate under the upper platform. Ease up the topmast rigging and stays, bring the top rope to the capstan, or man it, heave taut and take the weight of the mast, then out fid and throw back the pawl, then walk back the top rope until the heel of the mast bears on a plate and angle bracket on the lower mast, a hemp lashing is then passed through the fid hole and round the lower mast and secured. The position of the bracket on the lower mast is such, that when the heel of the topmast is resting on it, the head of the mast is still pointed through the trunnion hoop on the upper platform (*see* Fig. 9).

The distance from the heel to the trunnion hoop is the "housing" of the topmast.

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In striking the topmast in bad weather, the rigging and stays should be controlled whilst unfidding and lowering.

To send the Yards down.—The weights of the yards being small they can be sent down by the topmast gantline or pole gantline. Secure the gantline to the bunt of the yard and lash the bight out on one quarter, cast off the parrel and sling and then sway the yard, unshackle lifts and braces and lower on deck. The signal halliards can be either unrove before swaying or come down on the yard.

To Rattle down.—The lower shrouds are fitted with hemp ratlines which are seized to the foremost and after shrouds, and clove hitched round the intermediate ones. The shrouds are first frapped to and sparred down. The sheer-pole (a steel rod fitted across and seized to each of the shrouds just above the upper end of the rigging screws to support them and keep them in position) is first put on, then measure from the sheer-pole spaces 15 inches apart up the shrouds, marking them at the intervals; the ratlines are then put on at the marks, taking care that the hauling part of the clove hitch is always underneath. The seizings on the foremost and after shrouds are put on as follows:— The eye of the seizing (which is of 3-yarn nettle stuff) is spliced into the eye of the ratline, the seizing is then passed round the shroud, through the eye of the ratline, and back round the shroud the reverse way, and so on, until about seven turns have been passed; the end is then brought through the eye of the ratline, and clove hitched round all parts between the eye and the shroud.

Steel Wire Rope.* (*See* Table on page 109.)—The steel wire rope used for the standing rigging is made in sizes from 6½ inches to 1½ inches, but the largest size now issued is 4½ inches. The lengths of coils for the larger sizes from 5 to 6½ inches is 100 fathoms, from 3½ inches to 4½ the length is 150 fathoms, and below 3½ inches the length is 200 fathoms. There are 6 strands in each rope, there are 19 strands in ropes from 4 to 6½ inches; below 4 inches the number of wires in a strand is 7. It is all galvanised.

The standard breaking strain in tons is not less than the number of tons given by squaring the size and multiplying the result by 2½.

The wire rope used for running rigging is more flexible, having to reeve through blocks and sheaves, and is, therefore, composed of smaller wire, and is termed "*flexible steel wire rope.*" The sizes of flexible steel wire vary

* This does not refer to the steel wire hawsers supplied to ships in lengths of 150 fathoms

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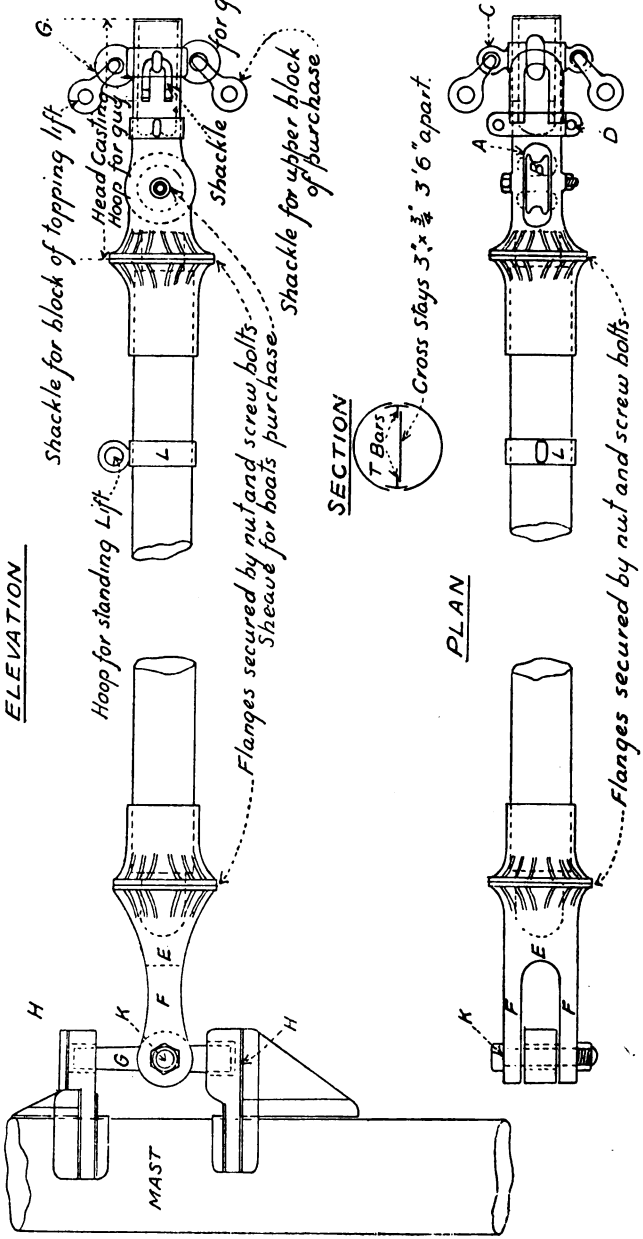

Fig. 13.

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from 1 to 8 inches. They are in coils of 150 fathoms in sizes from 4½ to 8 inches; 4 inches in coils of 240 fathoms; 3½ and 3 inches in coils of 360 fathoms; 2½ and 2 inches in coils of 750 fathoms; and below 2 inches, 300 fathoms. Each rope is of 6 strands, and from 6-inch to 8-inch there are 30 wires in each strand; for 5-inch and 5½-inch there are 24, and below 5-inch 12.

The standard breaking strain in tons is approximately given by multiplying the square of the size of the rope by 2 for ropes from 1 to 4 inch, and above 4-inch multiplying by 2¼.

Boat-hoisting Derricks.

All large ships carry a heavy steel derrick, generally on the fore side of the mainmast, for hoisting in and out the steamboats, launches, and pinnaces, which are stowed in crutches. The length of the derrick varies with the stowing position of the boats relative to the mast and with the breadth of the ship, but is usually from 45 to 65 feet, the diameter being from 17 to 19 inches at the centre, tapering to about 12 or 14 inches at the ends. It is built of steel plates bent to semicircular form, and connected at the edges by two **T** bars, which run the whole length of the derrick. The **T** bars are cross connected by bars spaced about 3½ feet apart. At each end the plating fits into a steel casting, and is well secured to it by rivets.

Fig. 13 shows in plan, elevation, and section, the construction and fittings of one of these derricks. The head casting A, which is connected by nuts and screw bolts to the steel casting on the derrick plating, carries a sheave B, through which the purchase is rove, and two hoops C and D. The outer hoop C has four eyes, one on top, to which is shackled the topping-lift block, one underneath, to which is shackled the upper purchase block, and one on either side, to which the side guys are shackled; the inner hoop D has two eyes, one on either side, to which are shackled two more guys. A hoop L, with an eye on the upper side, takes one end of the standing topping lift.

The heel casting E is formed with two jaws F F, between which fits a vertical spindle or tumbler G, whose upper and lower ends fit into metal sockets carried in thick plates, and secured by strong steel brackets H H on the mast, a pin K passing through the jaws and spindle. By this arrangement any motion, either of topping or traversing, can be given to the derrick. When topping, the derrick turns about the pin, K, and when traversing, the spindle G turns in the metal socket.

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When stowed, the derrick is horizontal, and rests on a crutch with semicircular bearing, with a semicircular hoop fitting over all.

The head of the derrick shown in Fig. 15 is somewhat different to that shown in Fig. 13.

Rigging of Derricks.—The rigging of a derrick worked by steam or electricity is shown in Fig. 14.

Two single blocks are slung from the under side of the derrick head and are used for the purchase. On the upper side of the derrick head there is a double block, through which the topping lift reeves. Three single blocks are slung from the mast, the two upper ones being for the topping lift, and the lowest one for the purchase. The purchase is rove as follows:—From the winding drum through a leading block on deck at the foot of the mast, up through the lowest of the three blocks on the mast, down through the sheave in derrick head, through the lower of the two purchase blocks through the upper purchase block on derrick head, and the standing part secured to the arse of the lower purchase block by a cringle. The lower purchase block is fitted with a hook which hooks on to the ring of the boat's slings. The purchase is a flexible steel wire rope of 4 or 4½ inches.

The topping lift is a flexible steel wire rope of the same size as the purchase, and is rove as follows:—From the winding drum through a leading block on deck at the foot of the mast, up through the middle of the three blocks on the mast, through one of the sheaves of the double block at the derrick head, through the upper of the three blocks on the mast, through the other sheave of the double block on the derrick head, the standing part being secured to the arse of the upper of the three blocks on the mast.

Four derrick guys of 3½-inch flexible steel wire rope are fitted, two on either side, one pair leading forward and one pair leading aft. These guys are fitted at their lower ends with purchases of 3½-inch cordage, the lower blocks of the guy purchases being secured to an eye-plate on deck. The standing topping lift is of 4-inch steel wire rope, one end being secured to the loop L (Fig. 13) on the derrick, and the other to an eye plate on the mast.

In the earlier derricks worked by hydraulic means, the rigging was similar to that just described, but in the later ships with hydraulic-worked derricks the leads are simpler, and are as shown in Fig. 15. In the latest ships the large blocks on the mast are abolished, their place being taken by large sheaves mounted on vertical trunnions which turn with the derrick.

In this case the boat's purchase D reeves from the hydraulic hoisting machinery space through a fairlead

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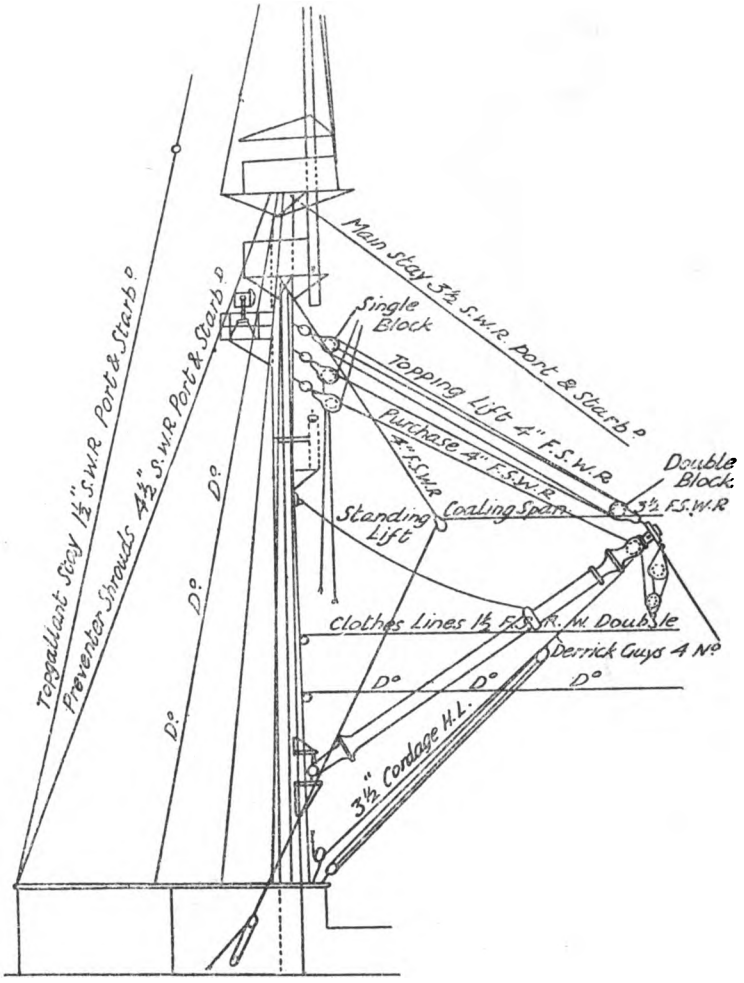

Fig. 14.

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ARRANGEMENT OF MAIN DERRICK.

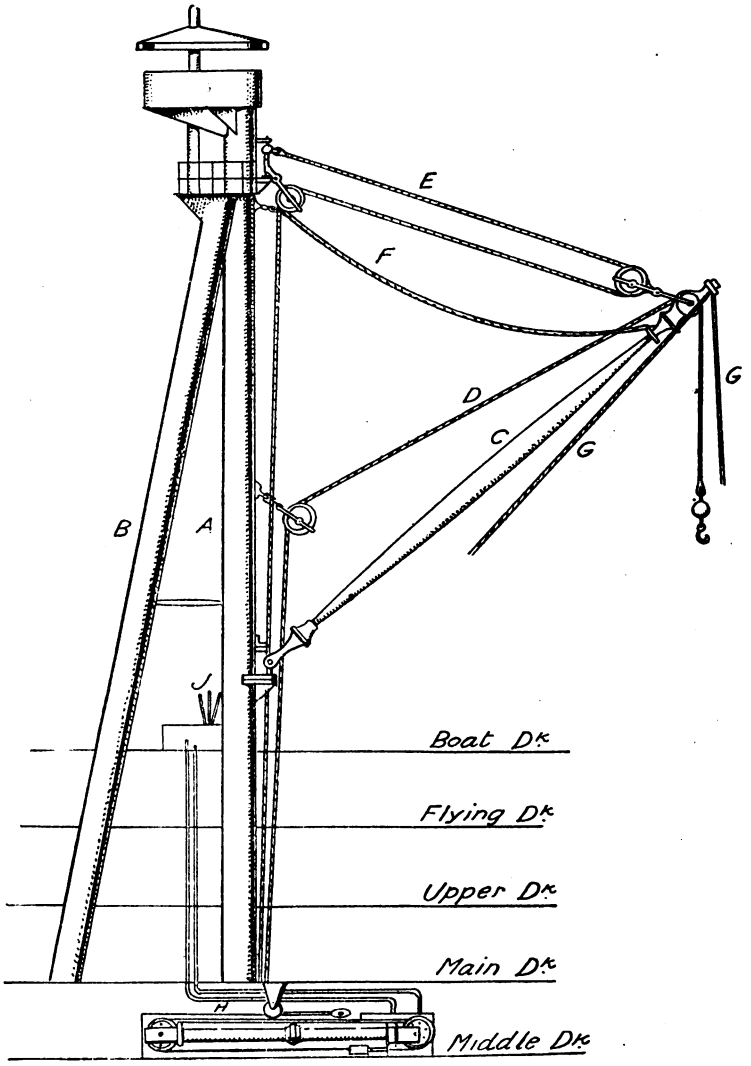

Fig. 15.

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DERRICK BLOCKS.

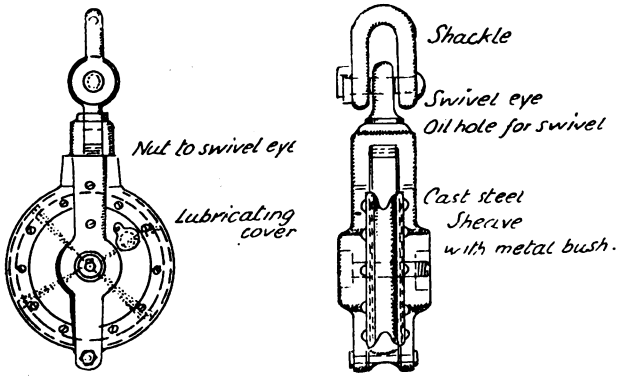

Fig. 16.

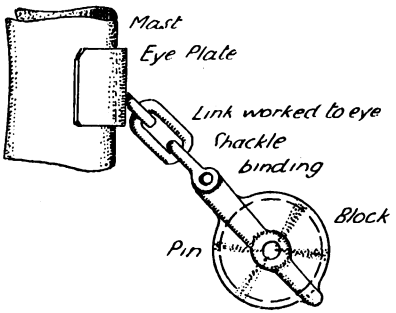

Fig. 17.

DERRICK BLOCK WITHOUT SWIVEL.

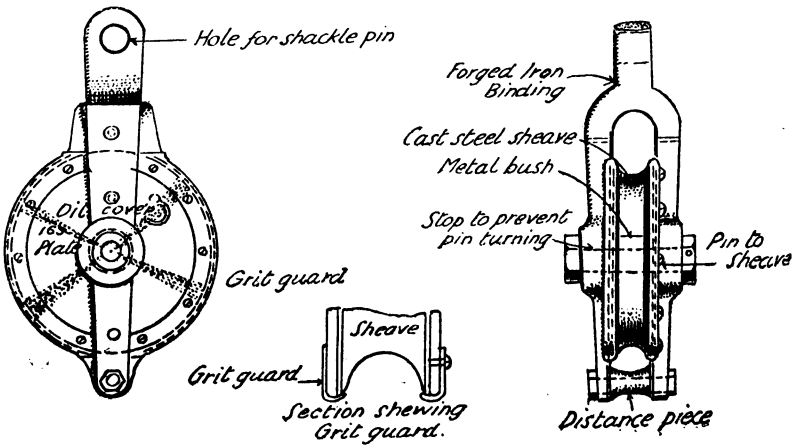

Fig. 18.

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at the foot of the mast, through a block on the mast just above the derrick heel, and through the sheave at the derrick head, the end being fitted with a weighted hook which hooks on to the ring of the boat's slings.

The topping lift, E, of 5½-inch flexible steel wire rope, reeves from the hydraulic machinery space through a fair-lead at the foot of the mast up through a block on the mast just below the control platform, through a single block at the derrick head, the standing part being secured to an eye-plate on the mast.

The remainder of the rigging is the same as before described.

Derrick Blocks.—Fig. 16 shows the construction of a single block fitted with a swivel eye through which the purchase and topping lift reeve. Fig. 18 is a block fitted without a swivel, and is the pattern used in the later ships. Fig. 17 shows the method of slinging the blocks to the mast; it will be seen that the pin of the shackle passes through the top of the binding of the block, the shackle itself passing through a link forged on an eye-plate on the mast.

Fore Derrick.—In some ships the sailing launch and pinnace are hoisted in and out by hand with the fore derrick; in other cases the lighter boats are got in and out with it, and it is also used for coaling. It is usually of wood with a forged steel heel formed, and similarly supported to that of the main derrick.

In some special cases two derricks are fitted, the heel of each being supported on the shelter or boat deck.

The purchase, which is of cordage, consists of two double blocks, and the purchase is rove as follows:—From deck through a block secured to the mast under the foretop, through a sheave at the head of the derrick, through one of the sheaves of the lower purchase block, through one of the sheaves of the upper purchase block at the head of the derrick, through the other sheave of the lower purchase block, through the other sheave of the upper purchase block at the head of the derrick, and the standing part secured to the arse of the lower purchase block.

The topping lift consists of a wire pendant shackled to the head of the derrick, and rove through a block secured to the mast under the foretop; to this pendant is shackled the upper block of a purchase, the lower block being shackled to a bolt on the fore shelter deck.

The derrick is fitted for four guys, but as a rule only two are used, consisting of a wire pendant secured to the derrick, and a small purchase shackled to the other end.

A standing topping lift is also fitted.

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Tests for Derricks.

It is essential that all fittings in connection with the hoisting in and out of boats should be thoroughly tested before being passed for use into the Service, as any accident due to insufficient strength may not only result in loss of life, but also serious damage to the ship's structure and the boats.

The steel wire ropes, blocks, links, and eye-plates on the mast are all thoroughly tested before being fitted in place. The test for the steel wire ropes has already been given (pages 109 and 336). The blocks, links, and eye-plates are tested with a test load of from four to five times the ordinary working load on them.

In addition, when the derrick and all work in connection with it is completed, the whole of the gear is tested in the following manner:—

(1) A load equal to twice the working load is held suspended at the end of the derrick and afterwards lowered. This is carried out on both sides of the ship at any selected position.

(2) A load equal to the working load is suspended from the derrick and lifted and lowered through the full lift at a definite rate.

(3) A load equal to the working load is lifted, topped, and lowered with a specified rate of topping.

(4) A load about 20 per cent. greater than the working load is lifted, topped, and lowered. The load is moved evenly at slow speed through the full range due to each motion, and the derrick is swung across the ship from one side to the other.

Boat-hoisting Machinery.—In the earlier battleships and cruisers the main derricks were worked by steam; in the later ones by hydraulic and electric means; generally it may be said that hydraulic hoists are fitted in battleships and electric in cruisers.

Arrangements are also provided for working the derricks by hand, by leading purchases along the deck, and connecting them to the wires of the derrick purchase and topping lift. The hand arrangements are, however, not to be used for drill purposes.

An electric or steam hoist consists of two grooved cast-steel drums, round which the purchase and topping lift are respectively wound, the ends of the wires being secured to a bolt passing through a standing eye on one flange of the drum.

The topping lift drum is sometimes made conical, the wire being wound on the smaller diameter when the

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derrick is horizontal, as in that position the greatest strain is brought on the topping lift; as the derrick is topped the strain decreases, and the wire is wound on the larger diameter.

Steam Hoists.—The drum is rotated by worm gearing which cannot walk back, and which therefore takes all jerks off the engine. To lower, the engine must be reversed.

Electric Hoists.—In the earlier pattern the drum is rotated directly by the motor shaft; if the current fails a spring brake immediately comes into play and holds the load in position. This brake is kept out of action when the hoist is working by an electro-magnet attracting a lever which controls it. For lowering, the motor is reversed, and the boat lowered by a foot-brake. The controller handle for starting the motor in the reverse direction should be put just far enough over to admit a current sufficient to take off the brake, so that a very small movement of the handle will put on the magnetic brake if so required. Resistances are provided by which the revolutions of the motor, and therefore of the speed of lifting or topping, can be regulated.

In a few recent battleships in which electric boat hoists have been fitted, the purchase and topping lift are each worked by two exactly similar winches. These winches stand on the middle deck and each consists of a motor whose shaft carries at its other end a worm which drives a worm wheel on a shaft in a direction running at right angles to the direction of the motor shaft. The other end of the shaft carrying the worm wheel is fitted with a small spur wheel, which drives a much larger spur wheel mounted on a shaft which also carries a grooved drum on which the wire of the boats' purchase or topping lift—both of 4-inch wire—is wound. The standing end of the purchase or topping lift wire is fitted with an eye and thimble and is connected by a shackle to the flanged end of the drum. The drum is about $3\frac{1}{2}$ feet in diameter and can take about 20 turns of wire. Two band brakes—one magnetic and the other mechanical—are fitted to the motor shaft between the motor and the worm already referred to. The mechanical brake can be controlled from the upper deck. The speed of lift is about 30 feet per second, but a controller is provided to allow of the speed being reduced. A similar gear has been fitted in some large cruisers.

Hydraulic Hoists.—Two main hydraulic rams are provided, one for the purchase and one for the topping lift. In some ships these rams are vertical and stand up, one on either side and close to the mast, but in the majority of

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ships the rams are horizontal, and in the latest ships are under protection.

The following description of the arrangement of rams, &c., applies to the ship whose derrick is shown in Fig. 15. The lifting machinery, that is the machinery working the purchase, consists of a fixed cylinder in which a ram works. At the closed end of the cylinder a sheave is fitted, and at the end of the ram farthest from the cylinder there is a crosshead fitted which carries two sheaves. The standing part of the purchase is secured to the lower side of the closed end of the cylinder, then reeves around one of the two sheaves at the end of the ram, then around the sheave at the end of the cylinder, then around the second sheave at the end of the ram, then through a fairlead near the end of the cylinder, and hence up to the block on the mast; it will thus be seen that there are four parts. With the boat in its lowest position the ram is close home in the cylinder; by putting on the pressure the ram is forced out, and the speed of lifting the boat is just four times the speed of the ram.

A small auxiliary cylinder and ram, capable of exerting about 5 tons, is fitted alongside the main lifting cylinder and ram, and is connected to the crosshead of the main ram, so that any motion outwards given to the auxiliary ram will consequently tauten the purchase, but would not be capable of lifting the boat; its use, therefore, is to keep the slings of the boat to be hoisted in taut, as it rises or falls with the motion of the sea, which prevents the slings becoming unhooked, and also prevents any undue strain due to jerking after the boat is hooked on and until the moment arrives for lifting the boat with the main ram.

An overhauling ram is fitted just above the lifting and tautening rams; it is used to bring home the lifting ram when right out of the cylinder—in other words, to walk back the purchase.

The cylinder for the topping lift carries four sheaves and the end of the ram three sheaves. The standing part of the wire is secured to the outer end of the ram and then reeves around one of the sheaves at the end of the cylinder, around one of the sheaves at the end of the ram, around another sheave at end of cylinder, around another of the sheaves at end of ram, and so on until all parts are rove, and then through fairleads, and hence up to block on the mast; there are thus eight parts. The ram is telescopic in two parts, the smaller ram fitting into the larger.

An overhauling ram is fitted above the main topping ram and serves the same purpose as that for the lifting ram.

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Of the methods described for working the main derricks, steam is undoubtedly the worst, as, being slow, the boat is unable to clear the water quickly, and in a seaway the boat's slings and the derrick are consequently subjected to heavy jerks.

Hoisting in a Steamboat.

The slings being fitted with a heavy ring on which are three legs with a hook at the end of each leg, it will be found more convenient to keep the slings inboard, and when about to hoist the boat in, to send them out, with the derrick, hooked to the lower purchase block; if the slings are kept in the boat it will be found that the heavy ring is difficult to man-handle, and in a sea-way the lower block moving about near the men's heads becomes a source of danger.

Having hooked the slings on to the lower purchase block, the derrick is put over the side, and the purchase lowered sufficiently to enable the men in the boat to hook the legs of the slings to the sling bolts, the centre leg hooking to a sling bolt in the engine-room or stoke-hold.

The slings being hooked and a bow and stern line secured to the boat from forward and aft, tauten the slings, then up purchase; the topping lift, guys, and purchase being worked as necessary. If there is any sea or any motion on the ship, rolling tackles should be used. The method of using them varies in different ships, but the principle is the same.

A boat-rope is led from forward through a block on the lower boom and secured to the bow of the boat (this is additional to the ordinary boat-rope).

A grass or small hawser leading through blocks as far out as possible is secured to the bow and quarter of the boat; the cutter's davits on the side the boat is coming in will generally be found suitable for the lead of the outer bow line, and the boat deck abreast for the inner bow line, the stern lines being led from the most convenient places; an additional stern line must be used in conjunction with the bow line from the lower boom, to prevent the boat surging forward or aft. Two jiggers should be ready near the boat's crutches to be hooked on to strops placed over the quarter cleats as soon as the boat is lowered sufficiently near.

In hoisting a boat in at sea, if so fitted, the slings should be first tautened, and the moment a lull occurs, up purchase and topping lift together till the boat is clear of the water; if not fitted with gear for tautening the slings,

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at the first opportunity as soon as hooked on, up purchase and topping lift full speed together.

The guys are worked by hand or from coaling winches, but with any motion on they should be well manned and carefully attended.

Never hoist a boat in or out with any men in her.

To work Main Derrick by Hand.—This method is only adopted when necessity occurs, and once in three months one or more sailing boom boats, and annually one steamboat, are hoisted in or out to ensure the efficiency of the hand gear, but on these occasions it is not to be looked upon as an evolution.

When requiring to work the main derrick by hand, a stopper is put on both wires just above the leading blocks at the foot of the mast and the wires taken off the drums, the two leading blocks then shifted to bolts on the two after casemates, in ships that have casemates, otherwise to convenient deck bolts; the wires are then led forward and shackled to special wires supplied for lengthening the purchase and topping lift to enable them to be rove through blocks shackled to bolts on the fore turret or forecastle. (In ships fitted with hydraulic hoists, independent wires are supplied on account of the difficulty of removing the purchase and topping lift wires from the hydraulic rams.) Both cat purchases are rove, one block of each being shackled to the ends of the wires, the purchases well overhauled, and the other blocks shackled to bolts well aft. (If the cat purchases were shackled to the purchase and topping lift wires direct, there would not be sufficient drift between the blocks to allow the boat to be hoisted sufficiently high.) The derrick can then be worked by hand-power by manning the cat purchases on the purchase and topping lift wires as required, the falls being led round the deck, and special men told off under an officer to attend the stoppers; the guys being worked as usual.

If the purchase should be out of action for any considerable time it may be found advisable to shackle the cat block direct to the derrick head, leading the fall down on deck through a leading block on the mast. This method was adopted for hoisting stores into the "Montagu" when she was ashore off Lundy Island, including an 18-ton boiler.

Sheers and Derricks.

To hoist any heavy weight on board a ship, in a position which the derricks fitted will not plumb, and the boat's davits are not strong enough, it is necessary to rig some extempore arrangement; either sheers or derricks can

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be used for the purpose. With the gear usually available in a ship, the latter can only be used for moderate weights, as a large-sized spar would be required to lift a really heavy weight.

Spare torpedo booms are not suitable for use as sheers or derricks, as they buckle very easily. As a rule the most convenient spars carried in ships, and suitable for these purposes, are those supplied for making a launch's mast. If away from a dockyard and larger spars are required, the two topmasts (in ships not fitted with topgallant masts) could be sent down and used as sheer legs.

The heels of sheers and derricks are stepped in shoes, which must be large enough to distribute the weight over a number of beams, and the deck must be well shored up. The shoes are either lashed or held by tackles, to prevent them from slipping.

Sheers.—To rig a pair of sheers, place the spars on the deck with their heels in line and close together and their heads crossed, place canvas round the spars at the cross and then lash the heads together with a round lashing, 11 round turns and 10 riding turns being generally taken; then open the legs, thus tautening the lashing. The sheer head lashing should be covered with canvas to prevent chafe; two wire stops are passed round it for the purchase and topping lift blocks.

The size of the purchase used depends entirely on the weight to be lifted, the cat purchase being probably the largest available.

The fall should be led through a leading block at the foot of one of the sheer legs.

The size of the topping lift similarly depends on the circumstances of the case, if possible the lead of the topping lift should be at right angles to the sheer legs when lifting the weight; if the head of the sheers has to be drooped far, it is essential that the topping lift should be taken aloft; if this is not possible, a mast might be improvised, the topping lift being either secured to it, or led over it (through a good block) and set up as far from the mast as possible.

The purchase and topping lift having been shackled to the strops that have been placed round the head lashing, two hemp hawsers are middled and clove-hitched over the heads of the sheer legs to form the guys and are set up with luffs. The heels having been opened out and placed on, the shoes are secured together by a tackle, two more tackles being placed on each sheer heel and set up at an angle of 120° from the cross tackle.

The distance apart of the heels should be one third the length of the sheer leg to the cross lashing.

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The sheers are raised by the topping lift, the guys and heel tackles being attended.

In rigging large sheers it may be necessary to rig a small pair to support the head whilst the sheers are being rigged and to assist in the first raising of them.

If necessary to move the sheers, soft soap must be placed on the deck and the heel tackles and guys worked.

The sketch, Fig. 19, illustrates a pair of sheers erected for the stepping of a lower mast, the length of which was 90 feet, and the weight, from 17 to 20 tons.

Length of sheer legs 70 feet.

A—Lashing of sheer legs. 2½-inch flexible steel wire rope, passed with 11 lower and 10 riding turns.

B—Strop for upper purchase blocks. 3½-inch bale sling, fitted with a thimble in each bight.

C—Guy pendants, fitted with thimbles at the ends; the pendants were 20 fathoms long and were clove-hitched over the sheer heads.

D—Guy purchases. 3½-inch tarred cordage rove through 11-inch blocks.

E—Upper purchase for topping mast in an upright position same as guy purchases. The upper block lashed to sheer leg with 2-inch flexible steel wire rope, the lower block shackled to 3-inch F.S.W. rope bale sling strop on the head of the mast.

F—Purchase blocks. 13-inch iron blocks, the upper ones being a double and a single and shackled to 3½-inch F.S.W. bale sling strops; the lower block a treble block and shackled to strop on mast.

The hauling part of the purchase rove through a block on heel of sheer leg.

G—Purchase fall. 3-inch flexible steel wire rope.

H—Strop of 4-inch F.S.W. rope, a grommet with thimble is seized in the lashing , the lashing being passed through and over one part only of the grommet.

I—Lashing on mast. 2½-inch F.S.W. rope, 11 turns through the strop and 2 dry turns round the mast, and the ends knotted and snaked down the mast.

J—5-inch stage lashing, 2 round turns round mast and then snaked down, the ends being tightly secured to prevent lashing from slipping up.

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[*To face page* 346

SHEERS FOR STEPPING MAST.

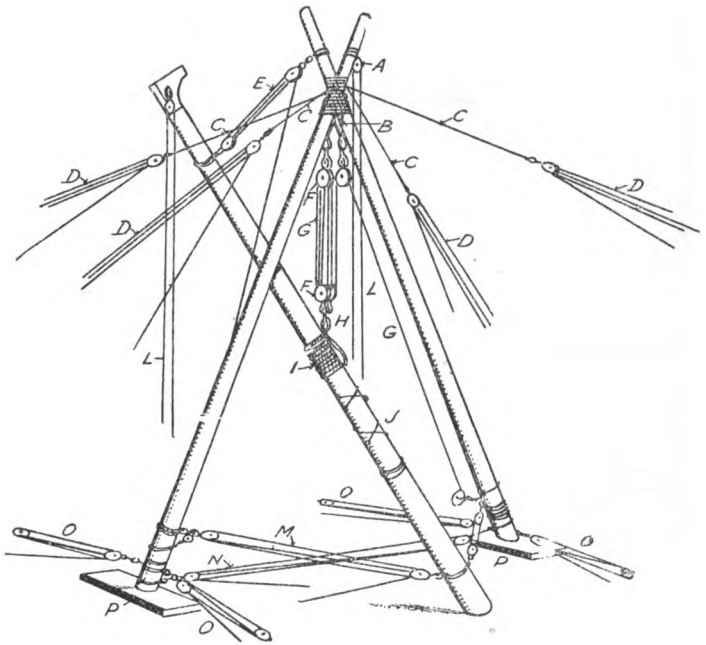

Fig 19.

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TEMPORARY DERRICK.

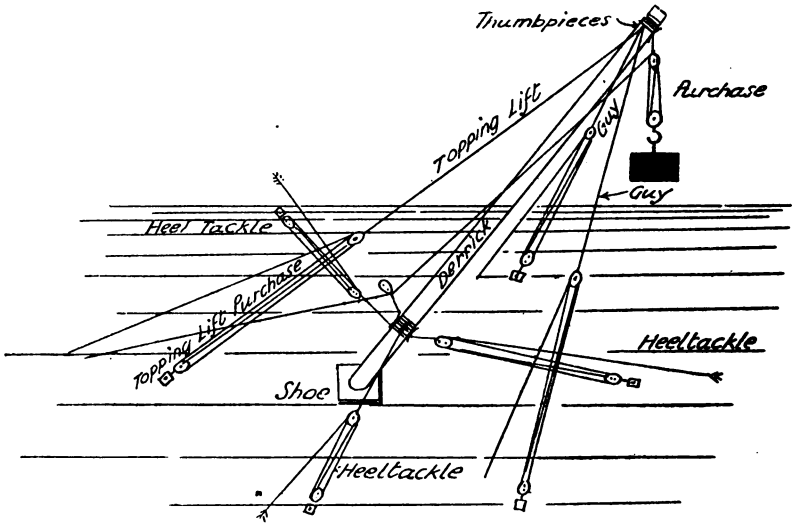

Fig. 20.

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RIGGING A DERRICK FOR A HEAVY WEIGHT.

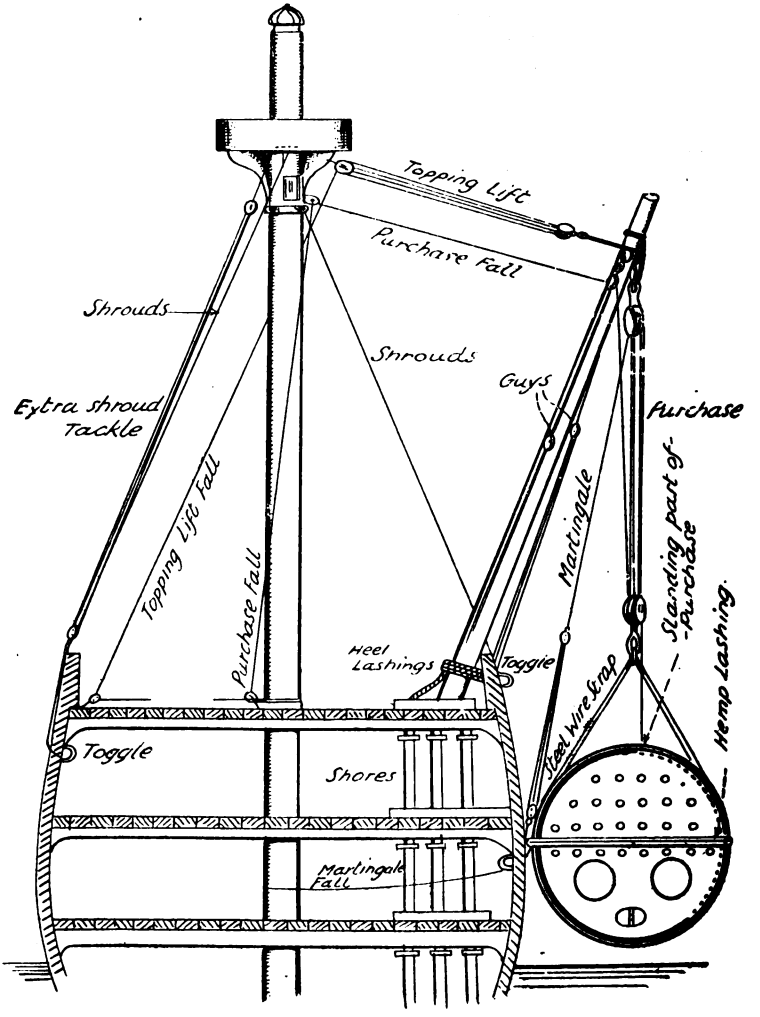

Fig. 21

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L—Gantlines. One from mast head, and one from sheer leg.
M—Guy tackle on heel of mast. 3½-inch luff.
N—Span tackle between sheer legs to prevent sheers from opening. Lashed to heel of sheer legs with 2-inch F.S.W. rope with cordage falls of 3½-inch H.L. tarred.
O—Tackles for securing heels of sheer legs.
P—Wooden shoes for heels of sheer legs to rest on, which are hollowed out in the centre to take the sheer legs.

Derricks.—Temporary derricks for lifting a heavy weight should not be swung with the weight on the derrick.

Wire or chain strops are placed round the head of the derrick for securing the purchase and topping lift blocks, and thumb-pieces secured to the derrick to prevent the strops from slipping down, the guys are placed on overall and set up with luffs; the greater the distance from the heel of the derrick to the point where the guys set up, the less the strain upon the guys.

All blocks used both with sheers and derricks should be thoroughly overhauled and careful calculations made of the stresses to which all parts of the system are to be subjected. Shackles or lashings should be substituted for hooks wherever it can be done; in other cases the hooks should be securely moused. If using winches for the purchase fall, no surging should be allowed either in hoisting or lowering; a heavy surge would double the strain.

In rigging a temporary derrick for lifting a moderate weight only, the fall of the purchase should be led through a leading block at the heel of the derrick, otherwise difficulty would be found in swinging the derrick and an unfair strain brought on the guys. The same precautions as to selecting a suitable place for the derrick should be taken as in the case of sheers. In both sheers and derricks, when they are well-topped and the fall of the purchase is taken aloft, there is a tendency to fall over backwards; where this may occur a martingale or jumper is put on to keep the head down. Care must be taken to keep the martingale clear of the purchase.

Fig. 20 shows a temporary derrick rigged for lifting a moderate weight, and Fig. 21 a temporary derrick for lifting a heavy weight.

NOTE.—This subject is further dealt with in Vol. II.

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COLLISION MATS.

Collision mats are used for temporarily stopping the rush of water through a hole made in a ship below the water-line. All warships carry at least one, the size of the mat supplied varying with the size of the ship. There are six different sizes of mats, viz.: 15 feet square, 12 feet square, 10 feet square, 8 feet square, 8 feet by 6 feet, and 6 feet by 4 feet, the largest size being carried by battleships and large cruisers, the 8 feet square mats by gunboats and sloops, and the 10 feet and 12 feet square mats by intermediate sizes of vessels; the 8 feet by 6 feet is carried by destroyers and 1st class torpedo boats, and the 6 feet by 4 feet mat by 2nd class torpedo boats.

The figure shows one of the largest sized mats.

All sizes are made of two thicknesses of canvas, the square mats having one thickness "thrumbed" and the other plain. The "thrumbed" side is placed against the side of the ship. A roping is worked round the sides of the mat, with cringles (D in fig.) along the sides, eyes (C) are fitted at the four corners for bending the lowering line, bottom line, and fore and afters to. Drain pipes (E) are fitted at the right and left-hand corners, on the canvas side. The 8 feet by 6 feet and 6 feet by 4 feet have both the thicknesses plain.

A in the figure is the lowering line, which is marked up to 10 fathoms as follows:—

1st	fathom	from	corner	of mat	– A piece of leather.
2nd	,,	,,	,,		– 2 pieces ,, ,,
3rd	,,	,,	,,		– 3 ,, ,, ,,
4th	,,	,,	,,		– Blue bunting.
5th	,,	,,	,,		– White ,,
6th	,,	,,	,,		– Yellow ,,
7th	,,	,,	,,		– Red ,,
8th	,,	,,	,,		– Black ,,
9th	,,	,,	,,		– Green ,,
10th	,,	,,	,,		– Piece of leather with a hole in it.

The lowering line is also marked between each fathom in feet by knots, 1 knot at 1 foot, 2 knots at 2 feet, and so on. (These are shown in the figure at B B B.) The lowering lines are 60 fathoms in length for the 15-feet and 12-feet mats and 40 fathoms in length for the 10-feet and 8-feet mats; they are of hemp cordage, and the sizes for the four mats are $4\frac{1}{2}$, 4, $3\frac{1}{2}$, and 3 inch. The two smallest mats are fitted with $1\frac{1}{2}$-inch cordage, 11 feet in length, to each of the four corner cringles. For the larger mats,

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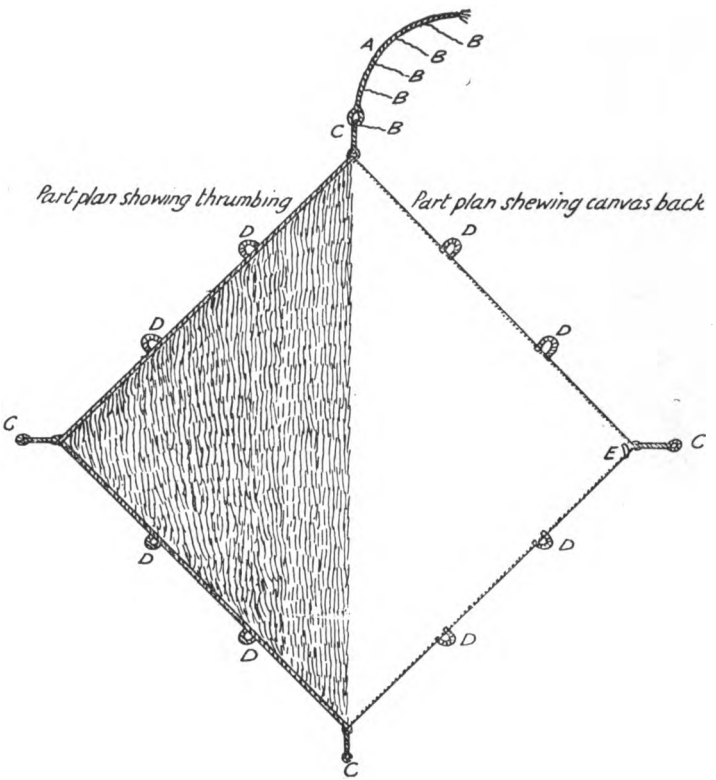
[*To face page* 348.

COLLISION MAT.



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5-inch and 4-inch coir hawsers are used for the fore and afters. The bottom line is of $\frac{5}{16}$ chain so as to take the chafe of the ship's bottom. Hitherto it has been the custom to supply a 4½-inch hauling down line to haul the mat into position, using the bottom line as a reeving line only. In future the hauling down line will be omitted, and tail pieces of 3½-inch hemp fitted to the bottom line, so that the latter may be used to haul the mat into the required position. The tail pieces must be of such a length that they will come well over the topsides and secure to a cleat. Two bottom chains are generally kept in place, one at each end of the ship, with the ends secured to cleats on the topsides to facilitate the placing of the mat quickly where required.

NOTE.—For further explanations in placing the mat, &c., *see* Vol. II.

A thrumbed mat is a piece of canvas with yarns pulled through it at regular intervals. It is made by cutting a piece of canvas to the length required, turning in both edges, marking off in line where the thrumb should be worked, being careful to put the line on the side where the ends are turned in. The tools required are a sailmaker's hook and a small spike. The hook is used to keep the canvas taut whilst using the spike. Cut the yarns to be used in lengths of 3 to 4 inches, then commence with the spike on the first line, making a hole large enough to pull the thrumb through, and so continue about every ½ inch across the line. The thrumb should be formed of a number of yarns, according to the thickness of the mat required.

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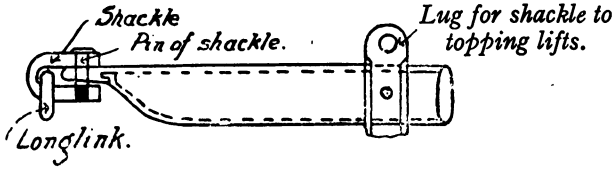
TORPEDO NET DEFENCE.

All battleships, and some of the armoured cruisers, are fitted with torpedo net defence for protection against attack by torpedoes. In earlier ships this defence was fitted completely round the ship, but in the latest vessels the extent is about three-quarters the length, in fact just long enough to protect the magazines and shell rooms at the ends. The defence consists of a number of nets formed of small interwoven steel wire rings kept in position by a number of booms standing out at right angles to the ship's side, and by their rigging.

The booms are formed of mild steel tubes about 7½ inches diameter and about 30 feet long, spaced about the same distance apart. The heels are supported about 6 to 8 feet above the water, and the booms slope slightly, so that their heads are about 3 or 4 feet above water.

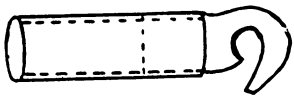
At the head of the boom the tube is flattened out for about 4 inches and the end is filled in, so that the tube is completely closed. The flattened portion is horizontal, and through it a vertical hole is drilled to take the pin of a shackle. This shackle projects beyond the end and supports a long chain link to which the shackles of the jackstay are secured.



Head of Boom.

About 4 feet from the end of boom a hoop is fitted, provided with a lug on the upper side. A hole through this lug takes the pin of a bow shackle to which are secured the topping lifts.

The heel of the boom is fitted with a forged iron hook, the opening of the jaws of which is somewhat contracted.



Heel of Boom.

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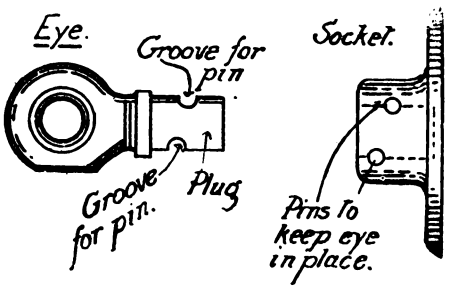
This hook fits into an eye carried by a socket on the ship's side. The eye is of the form shown below, being cut away on the foreside. The cut-away portion which



is on the foreside allows of the contracted opening of the hook passing over it, but the opening is too small to allow of the hook passing over the ordinary part of the eye. The boom when stowed aft or when in position perpendicular to ship's side cannot with this arrangement become unshipped from the eye. The eye has a plug end which ships into a socket rivetted to the bottom plating, or to the side armour. The eye is kept in position in the socket by two pins which fit into vertical holes through the socket, and when in place pass halfway into the eye-plug, and halfway into the socket. These pins are fitted each with a jack chain whose other end is secured to an eye screwed into the socket.

The semicircular grooves in plug for these pins are cut away so that the plug can move round through 10 degrees one way and 20 degrees the other.

In one or two ships a special heel fitting patented by Messrs. Bullivant is fitted. In this arrangement the heel of boom is fitted with an eye instead of a hook. The socket on ship's side is hollowed out to receive the eye, and a pin passed through socket and eye on boom. This pin is prevented from rising by a special locking contrivance.

The foremost and aftermost boom, and also the middle boom, on each side of the ship, are made slightly larger in diameter than the ordinary booms. The flattened end of the end booms has two holes to take the pins of two shackles, and does not carry a long link. These booms also carry an additional hoop near the head with a horizontal eye to secure the working guys. The foremost boom has the lug on the foreside and the aftermost on the after side. The middle boom has the additional hoop with a horizontal lug on each side to take working guys on either side. All shackles are fitted with screw pins with flush heads.

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When stowed, the heads of the booms are at about the level of the shelf fitted to stow the nets. Chocks on the side of ship, either of wood or plate, and angle bars at about the middle of the boom with a semicircular bearing take the booms when stowed, a hinged semicircular clamp fitting over all; chains and slips secured to eye-plates on the ship's side are also fitted near the heads to keep the booms in their stowing position.

Rigging of Booms.

Each boom has two 3½-inch steel wire topping lifts (D in fig.). The two outer ends are secured to a bow shackle whose pin fits into the hole in the lug of the hoop. The inboard ends are secured by slips and bottle screws (E in fig.) to eye-plates on the ship's side just under the net-shelf. The length of topping lifts is such that when stowed the fore lift is taut. A jackstay (C in fig.) of 3½-inch steel wire rope runs the whole length of the defence, and is secured to the head of each boom. It is fitted in short lengths between consecutive booms. The fore end of each length is fitted with a slip and bottle screw secured by a shackle to the long link carried at the head of each boom (except the foremost and aftermost). The after end of each length is not fitted with slip and bottle screw, but shackles direct to the long link. As the foremost and aftermost booms carry no long links but two shackles, the ends of the first and last short lengths of the jackstay are secured to one of these two shackles. The end booms are fitted with standing and working guys (F and G in the fig.). For the after boom, F is secured to a shackle at the head of boom and is secured by slip, bottle screw, and shackle to an eye-plate on the ship's side. For the forward boom the standing guy F reeves through a sheave on ship's side at the level of jackstay, thence up through a sheave on deck edge, and then leads aft, being fitted with a purchase, one block of which is secured to the shelter bulkhead or other convenient position. The outboard ends of the working guys G are shackled to a lug on the hoop at the head of the end booms already mentioned, and reeve through leading blocks on deck edge, and thence to the capstans at either end of the ship.

The middle boom on each side has working guys H leading from shackles on the lugs of hoop near the head to leading blocks on deck edge, the inboard end of each being fitted with a purchase. These guys are used to assist in getting the defence in or out.

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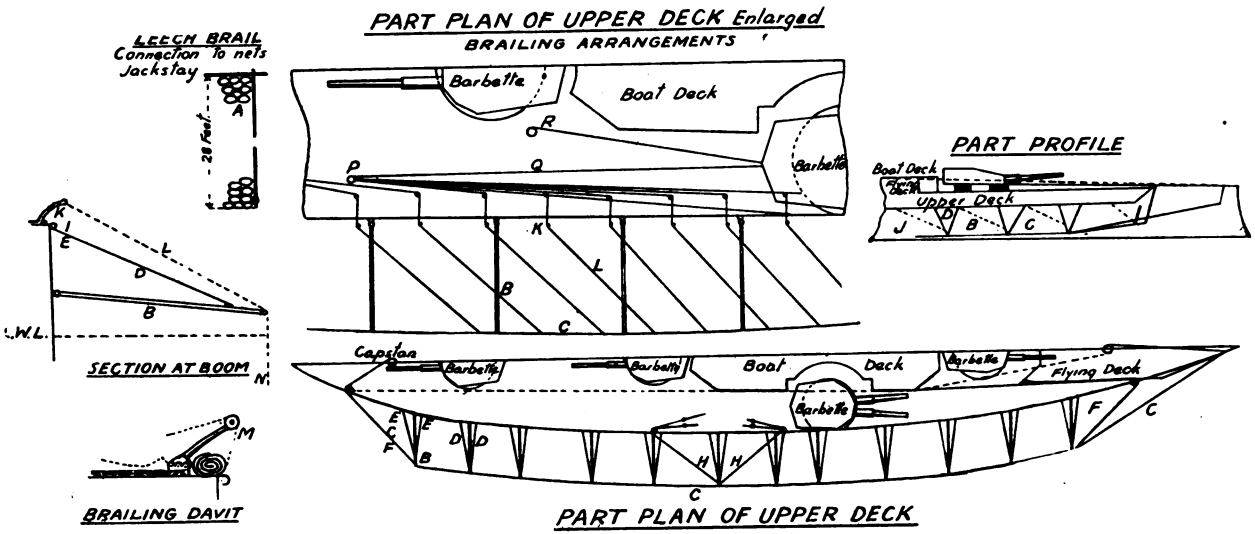
TORPEDO NET DEFENCE.



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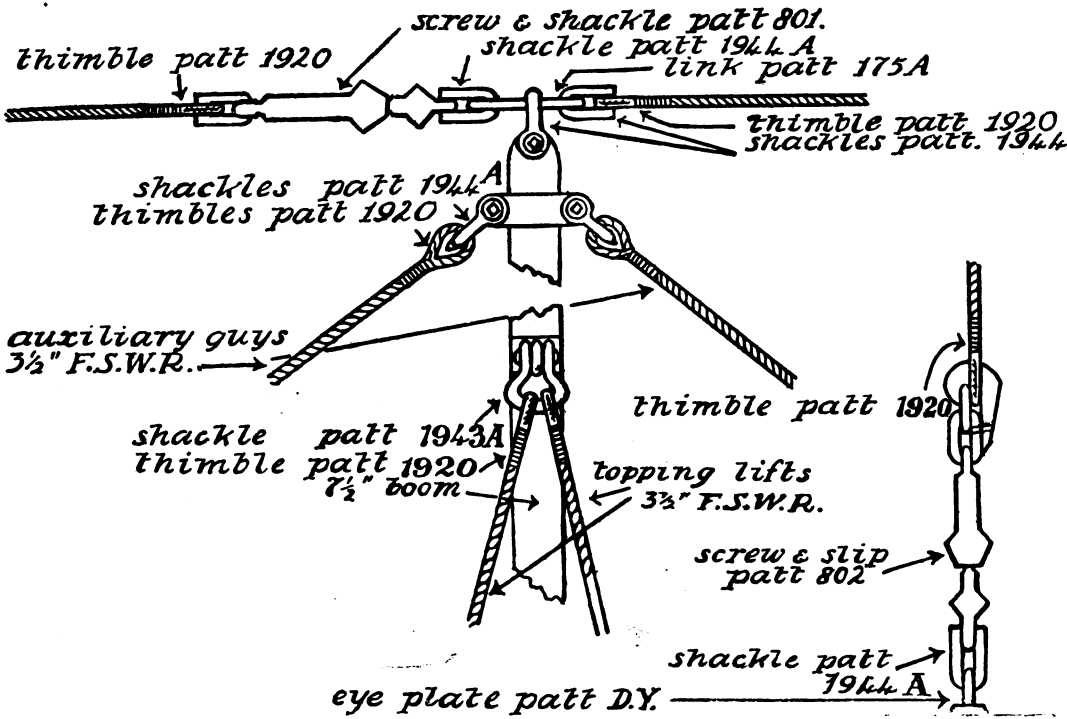
Rigging of Torpedo Booms.



Shackles, Patt. 1943A. Proof Test, 20 tons.
" " 1944B. " " "
" " 1944A. " " 16 "
Links, Patt. 1751. Proof Test, 20 tons.

Shackles and Screw, Patt. 801. Proof Test, 18 tons.
Slip and Screw, Patt. 802. Proof Test, 18 tons.
" Shackle " 1915. " " "

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Nets and their Stowage.

The nets are made of interwoven steel wire rings. They were formerly of steel wire rings fastened together by smaller steel rings. The size was formerly 20 feet by 15 feet, the 20 feet being the depth, but in the latest ships the length and depth have both been considerably increased. The upper sides of the nets are provided with iron wire head-ropes which are laced by steel wire to the jackstays. The ends of the nets are connected together by small wire spirals, the edges being crossed and forming a double part between the spirals. When stowed the nets rest on net-shelves. In the majority of ships these are built outside the ship, in battleships at the level of the main deck, and in cruisers at the level of the upper deck. Spaces are left to allow of the housing of the heads of the booms. In the latest ships the edge of the upper deck is used for the purpose, the planking being cut back to allow for this being done, and a perforated plate fitted with curved outboard end projecting about 12 inches over the side. The nets when stowed are rolled up and are kept in position by various means. In some ships chain spans with two legs are used, the standing parts of the legs being secured to lugs on the side above the shelf, the middle passed under the net and secured by rope lashing to triangular links above the net on the ship's side. By cutting the lashing the nets are free to fall over.

In the latest ships steel wire spans are fitted about eight feet apart. The ends of these spans are secured to eye-plates on the ship's side, and pass over the nets, and are secured by lanyards to slips on the deck or beading.

The figure shows the method of getting in the net defence and stowing it. Brails L of steel wire rope with standing part of chain secured to the shelf at the feet of small davits K, placed about 16 feet apart on upper deck, pass between ship's side and net, under the latter, up over the jackstay, to the sheave in davit head. The inboard ends of brails pass round sheaves O, and are taken aft in groups passing through a clump block and are then shackled to a purchase Q, the fall of which is brought to the coaling hoist R. By easing the foremost standing and working guys and hauling in on the after working guy of the midship boom, and after working guys, the booms swing aft against the side, and by hauling in on the purchase Q, the nets are brailed and furled on the net-shelf.

With the smaller depths of net in the older fitted vessels, brailing could be carried out by hand, with men about 4 or 5 feet apart standing on the net-shelf. Brails are spliced into the foot of the nets, and as the defence

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comes to the side these brails are hauled on simultaneously until the foot of the nets comes on the shelf. The nets are then furled hand over hand.

Another method used in ships where the shelf is comparatively low, is that known as the " parbuckling " method. In this case the brails are from 4 to 5 feet apart and of cordage. The length of brail is about twice the depth of net with 2 or 3 feet extra to work on. Clips or hooks are fitted at either end. When the nets are in position the brails hang on either side of the net, the ends being hooked to the head-rope. As the defence comes to the side the end of the brail between net and ship's side is unshipped from head-rope and hooked to the shelf, and the other end unhooked and led to the upper deck where it is manned. By hauling in on the inboard ends the net is hove up and furled.

The figure also shows the " leech brails " which are fitted to the foremost and aftermost extremities of the nets. These brails are connected each by a shackle to the lower side of net, with shackles through which they pass on the grommets at the ends of nets. The " leech brails " pass up over sheaves slung on the jackstays, and are led to the bollards or other convenient positions.

NOTE.—This subject is further dealt with in Vol. II.

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COALING.

The accompanying sketches show the methods of rigging the coaling appliances from a collier :—

(1) By the Yard and Stay method.

(2) By the Whip and Out-haul method.

Rapid coaling of H.M. ships being essential for the efficiency of the Service, no detail however small should be left undone to ensure that the coal is shipped and stowed in the shortest time possible.

Before commencing to coal, a plan should be prepared showing the quantities of coal required in each bunker, in order that the necessary arrangements can be made for clearing the coal off the upper deck and to arrange the system of traffic about the decks.

It is essential that the stations be worked out for every individual man, and once having been satisfactorily obtained should be strictly adhered to.

Each whip should have a separate "dumping ground," *i.e.*, the two whips working from the same hold should not both land the coal in the same place. This becomes more important as the rapidity of coaling increases.

It is important in rigging whips to have the leads as simple as possible.

The hauling parts of the whips should be led as high as possible in the ship, and specially picked men placed in charge of the out-hauls.

Every whip should be duplicated ; and the whip shifted as soon as it shows signs of wear and tear ; never wait for the break, but shift it before it occurs.

Whilst whips are being rigged it is advisable to prepare about 10 hoists full in every hold ; more than that is worse than useless, as the full bags get in the way of the fillers when the "Commence" is ordered, and men are standing easy who should be at work.

The first few hoists should not be worked too quickly. Every detail should be seen to be correct, and every part working smoothly ; then rapid coaling can commence.

NOTE.—This subject is further discussed in Vol. II.

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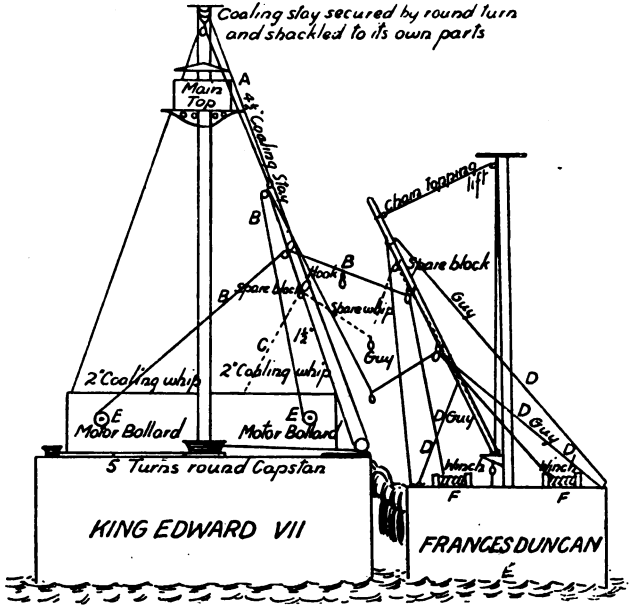
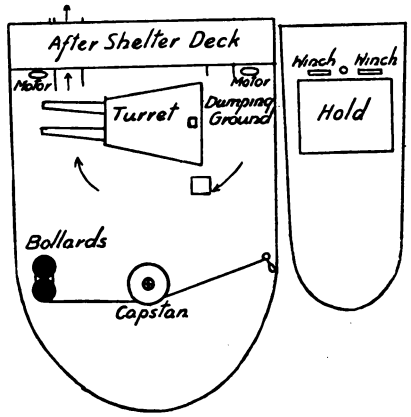
YARD AND STAY METHOD.

Elevation.



A 4½-inch Coaling Stay.
B 2-inch Coaling Whip.
C Spare Coaling Whip.

Plan



D Guys.
E Motor Bollards.
F Steam Winch.

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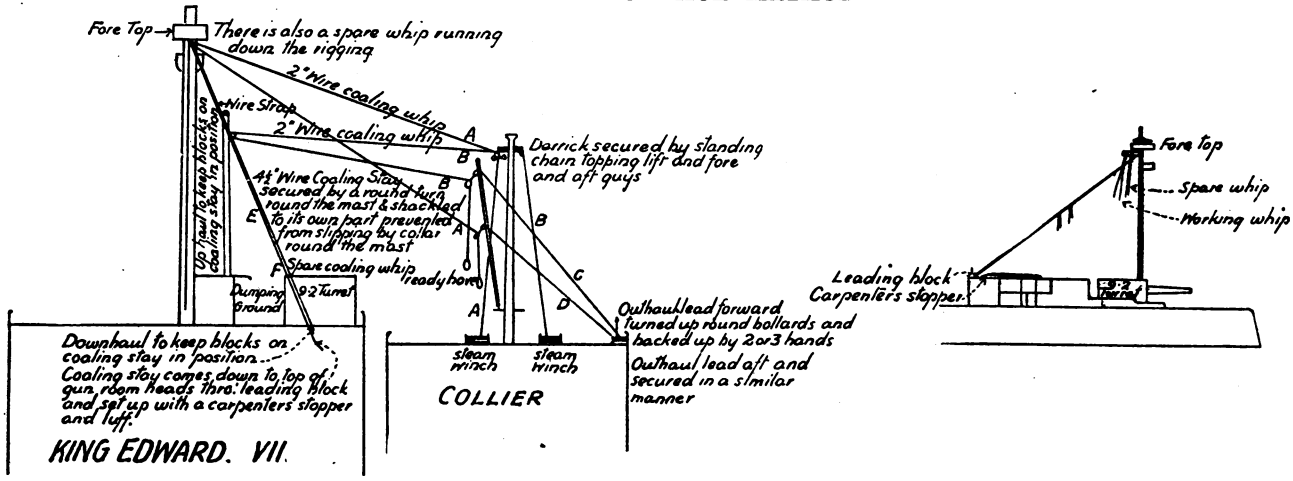
WHIP AND OUTHAUL METHOD


Fore Top
There is also a spare whip running down the rigging
2" Wire coaling whip
Wire Strop
2" Wire coaling whip
Up haul to keep blocks on coaling stay in position
4½" Wire Coaling Stay secured by a round turn round the mast & shackled to its own part prevented from slipping by collar round the mast
Spare coaling whip ready hove
Dumping Ground
9.2 Turret
Downhaul to keep blocks on coaling stay in position. Coaling stay comes down to top of gun room heads thro' leading block and set up with a carpenters stopper and luff.
KING EDWARD. VII.
A
B
B
A
B
C
A
D
Derrick secured by standing chain topping lift and fore and aft guys
Outhaul lead forward turned up round bollards and backed up by 2 or 3 hands
Outhaul lead aft and secured in a similar manner
steam winch
steam winch
COLLIER
Fore Top
Spare whip
Working whip
Leading block
Carpenters stopper
9.2 Turret

A 2-inch Wire Coaling Whip.
B Do. do.
C and D Outhauls.
E 4½-inch Coaling Stay.
F Halliard on Stay in Position.

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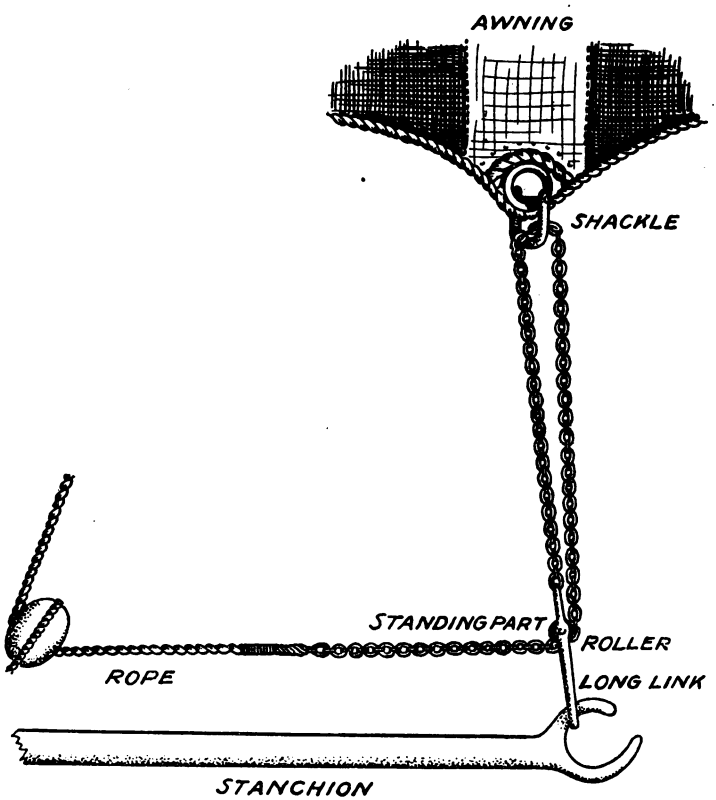
CHAIN EARRING.



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AWNINGS.

Awnings are made of No. 2 Royal Navy canvas, the various breadths composing it running across the ship and being sewn together. A wire roping is worked round the side edges of the awning, being sewn and served in, with cringles worked in the wire. The fore and after ends have a double part of canvas, and the cringles or eyelets worked into small roping for earrings.

The wire ropings now worked into the sides of the awning do away with the standing wire side ropes formerly fitted.

Eyelets are fitted on the awning about an inch inside the roping for the curtains to be stopped to, which is neater, and enables the curtains to be stopped close up to the awning. The awning is supported when in place by the centre ridge rope at the middle line of the ship, which rises from 4 to 5 feet above the sides at the greatest breadth of the awning, falling to the same height at the bow and stern.

Method of Spreading.—The centre ridge rope is a standing one of 2½-inch flexible steel wire covered with canvas and set up at each end with a slip and screw. At the stem and stern it is set up to the middle line awning stanchion, and the inboard ends to the shelter bulkheads, or other similar convenient positions.

The quarter-deck and forecastle awnings are made in one piece, and are spread flying over the centre ridge ropes, being hauled out to the sides of the ship by chain earrings tailed with rope. Large awnings are often fitted with spilling lines. These lines lie over the awning from cringle to cringle. They are used in either hauling the awning over the ridge rope, in spreading and holding it until the chain earrings are passed, or for hauling it back when furling. It is also necessary in large awnings to use a top whip to one of the cringles in order to take the weight while hauling over.

The chain earrings reeve over a roller revolving on a pin fitted across a long link, the other end of the link passing over a horn worked on the inboard side of the awning stanchion, or on a boat's davit. The chain earring, after reeving over the roller, is led to the deck. Cleats are fitted for taking a turn with the rope tailing. Sheaves are also fitted at the middle and sides of the shelter bulkheads to take the chain earrings. Small jiggers are fitted in the larger awnings in place of the chain earrings, at about every third stanchion.

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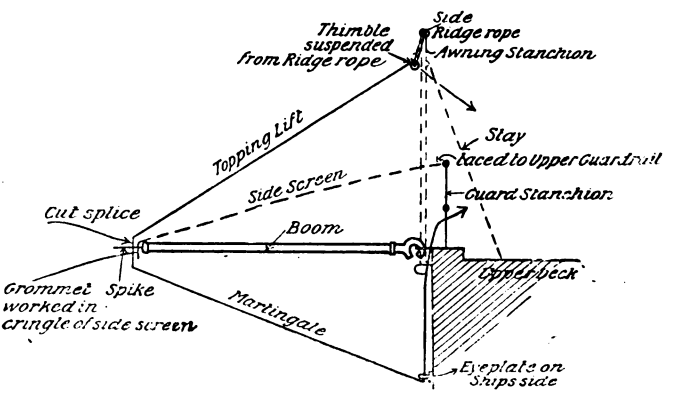
In the waist of the ships, awnings are fitted from the funnel casings to the side. A jackstay is fitted along the casings to which the inboard side of the awning is laced, the outboard side being laced to a side ridge rope.

In smaller ships fitted for tropical stations double awnings are fitted; these are parallel to each other, and about a foot apart.

Awning Curtains are provided for one side of the ship only, but can be used on either side. They are made of No. 6 Royal Navy canvas and are hung from the eyelets on the awning, and extend down to within about 6 inches of the deck. Eyelet-holes are worked along the bottom for stopping down to eye-plates on the covering board. They are also fitted with furling stops, for securing when the curtains are rolled up.

Awning curtains should be kept scrupulously clean, and when not in use kept in the bags supplied for the purpose.

Side Screens are fitted to protect the cabins aft, and also the sick bay from the direct force of the sun's rays in hot climates. They are made of No. 6 Royal Navy canvas and are kept in position by booms about 10 feet long and about 10 feet apart, heeled to the edge of the deck, and provided on their outer ends with spikes, which reeve into grommets worked in cringles on the outer edge of the side screen. They also take a cut splice formed on a hempen rope, which forms a combined topping lift and martingale for the booms. The arrangement of booms, rigging, and screen can be seen from the sketch.



NOTE.—For further remarks on awnings *see* Organisation, Chapter I., Vol. II.

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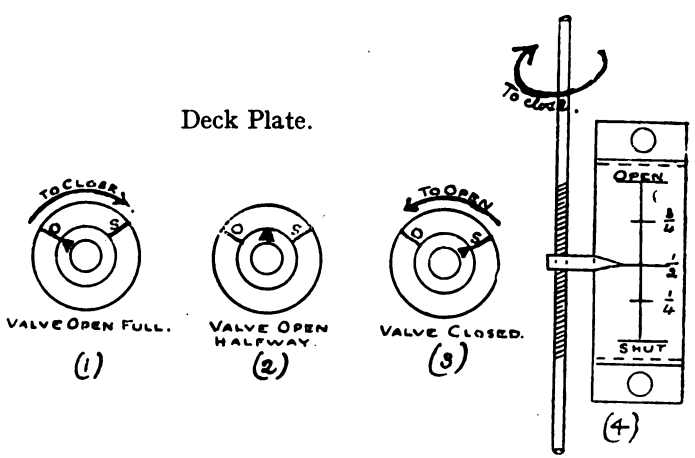
CHAPTER X.

MISCELLANEOUS.

Watertight Doors and Valves.

All watertight doors and valves are fitted with deck plates, generally on the main deck, from which they can be worked. In addition valves are fitted with handwheels between decks, or near the valves, from which they can be opened or closed. The deck plates are always stamped on the flat with the name of the valve for which they are fitted, and a small label plate is fitted near the handwheel to indicate the same. Marks are also provided, by which the position of the door or valve (*i.e.*, closed or open) can readily be seen.



At Deck Plate.—To operate the door or valve from deck, the plug to the deck plate must first be removed. This is done by inserting the end of a spanner into the triangular or rectangular slot in the plug and unscrewing; with the plug removed, the square end of the valve or door spindle is exposed to view (except for magazine valves, which are

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fitted with locked caps, and which must be unlocked and removed before the spindle can be seen). A box spanner with a T handle is then inserted over the square end of the spindle and turned as necessary. The natural position of all doors and valves is "closed." To open, the spanner must be turned in a left-handed direction, that is, in the opposite direction to the hands of a watch or clock, lying on the deck face upwards (*see* Fig. 3).

In the latest ships the upper ends of the spindles and the box spanners are made of different shapes for the various valves, doors, &c., so as to prevent confusion. Thus, for a flood valve the end of the spindle is made triangular shape; for a sluice or drain valve, square shape; for a suction valve, elliptical; for a ventilation valve, hexagonal; and for a watertight door, square with the corners rounded off.

If the door or valve is open, and it is required to close it, the spanner must be turned in a right-handed direction, that is, in the same direction as the hands of a watch. To serve as an indication as to the position of the door or valve, marks are scored on the deck plate. Two radial marks are placed on the fixed part of the deck plate and are stamped "open" and "shut" (O and S in Figs. 1, 2, and 3). There is another mark on a part of the plate which moves with the spindle; if the inner mark is opposite to the mark on the deck plate labelled "open" the door or valve is full open (Fig. 1). If the inner mark is opposite the deck plate labelled "shut" the valve or door is closed (Fig. 3). If the inner mark is between the two outer ones, the door or valve is partly open (Fig. 2).

The order being to "close," the spanner must be turned until the inner mark is opposite "shut." It may happen that the valve seating, being a little worn, the inner mark will go slightly beyond the mark labelled "shut"; it is, therefore, important in closing, even if the inner mark is opposite "shut," to exert force on the spanner to see if it will go beyond. If, on the contrary, the inner mark will not go over to the "shut" mark, it is a clear indication that there is some obstacle in the way, and the fact must be at once reported so that steps can be taken to remove it.

It will be noticed that the direction of rotation of the spanner is given by the letters on the deck plate. Thus, if the valve or door is "open" and it is required to "shut," turn the spanner in the shortest direction from "open" to "shut" on the plate; if the valve or door is "shut" and it is required to "open," turn the spanner in the direction of the shortest distance from "shut" to "open" on the plate.

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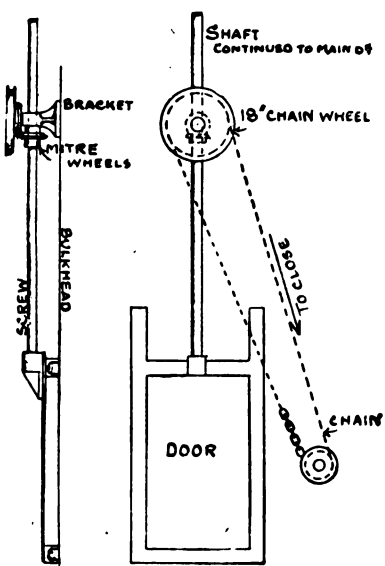
At Handwheel.—To operate a valve between decks by the handwheel, the motion of the wheel for opening or closing the valve is the same as that described for the spanner. An indicator plate is fixed on the bulkhead near the wheel on which are marks "open" and "shut," and also marks showing if the valve is a ¼, ½, or ¾ open. A small pointer moves up and down as the valve spindle is rotated, and the position of the valve is shown by the pointer (Fig. 4).

In Fig. 4 the valve is shown as being half open.

Closing Sliding Watertight Doors from Below.—In addition to the deck plate already mentioned, each sliding watertight door is provided with means by which it can be opened or closed from below, at or near the door.

For a horizontal sliding door a hexagonal form is given to the shaft actuating the door for about 3 inches of its length. A spanner (stowed near) fits this hexagon, and by it the door can be opened or closed. The process is necessarily slow.

For vertical sliding doors, such as bunker doors, a quicker arrangement is fitted. Just above each door a sprocket wheel is fitted, over which passes an endless chain. The bight of the chain hangs down alongside the door, as shown in the figure.



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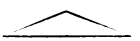
By pulling the chain the sprocket wheel is turned, and in turning causes the spindle of the door to revolve and thus opens or closes it.

To close it the right-hand side of the bight of the chain should be pulled down hand over hand. To open it the left-hand side should be pulled down.

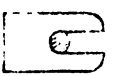
Hinged Watertight Doors.—The doors are tautly hove up by clips, which are fitted through the bulkhead round the door, and project on each side of the bulkhead. There are usually 8 or 10 of these clips, and each bears on a wedge piece fitted on the door. Each wedge piece has two wedged bearing surfaces.



When the door is open the clips are in the positions shown by the dotted lines in the figure. A spring is fitted to the top clip to prevent it falling across the doorway.

When the door is closed the clips should be hove down on the wedges in the direction shown, the upper side clips being made to bear on the upper portion of their wedge pieces, and the lower side clips on the lower portions of their wedge pieces. When the whole of the clips are bearing, a final pull should be applied to each clip to ensure the door being as tightly closed as possible.

Watertight Scuttles.—A watertight scuttle or hatch cover fitted to a coaming (that is a raised framing round an opening) is secured, when shut, by means of butterfly nuts. These nuts, which are of gun-metal, work on steel bolts hinged to the coaming plate. The butterfly nut and bolt fall back against the coaming when the scuttle or cover is open. Lugs are fitted round the cover in wake of each butterfly nut, projecting beyond.

The lug is provided with two jaws, 

between which the bolt fits. The figures show the arrangement, and indicate by the arrows the direction in which the butterfly nut must be turned to heave down the cover tight upon the rubber.

Flush Scuttles, or scuttles which fit down close on the deck without a coaming round the opening, are of necessity closed in a different manner to that described above. In such cases wedge pieces similar to those fitted on a hinged watertight door are used, and the clips are

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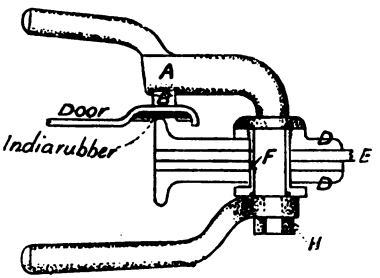
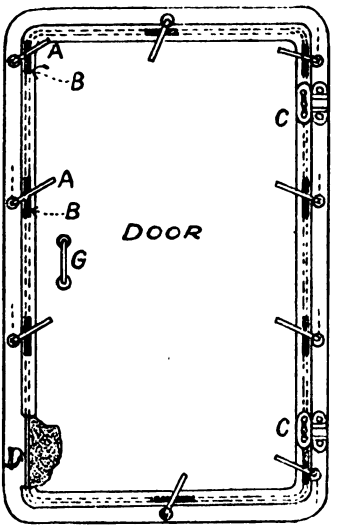
[*To face page* 362.

MECHANS EMBOSSED STEEL HINGED W.T. DOOR.

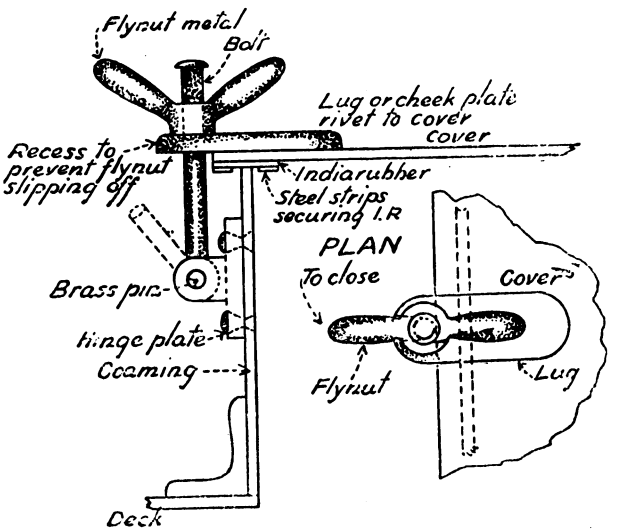
Section thro' Clip.



A Clip.
B Wedge (metal).
C Hinge.
D Frame.
E Bulkhead.
F Metal Bush.
G Handle.
H Leather Ring.



METHOD OF FASTENING HINGED W.T. SCUTTLES.



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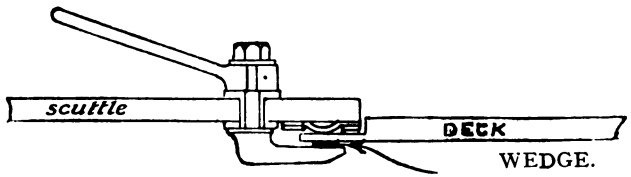
very similar to those for doors, but are worked from the top only, except for escape scuttles where they are worked from both above and below.



Man Overboard.

The principal danger to a man falling overboard is that of being struck by the screw. This danger is of course increased in a ship with twin-screws, and is again increased by throwing the stern of the ship to the side on which the man has fallen over.

If a light buoyant object is thrown overboard from forward it will be found that by the time it reaches the stern it will be well clear, having been thrown off by the surface wash from the side. A *man* falling overboard may feel this wash to a certain extent, but he at first sinks far below its influence and into the suction of the screw. Moreover, his first instinct is to swim back towards the ship.

The first thought, therefore, of a man falling overboard should be to swim *outward* from the ship, and the first thought of the officer of the watch should be to stop and *not reverse* the engines. If it is known from which side the man has fallen, the helm should be at once put over to the opposite side, throwing the stern away from the man. If the ship is in company with others the action of putting the helm over must be governed by the formation of the ships at the time and the distance apart of the columns, the first consideration of the officer of the watch being the safety of his own ship and of the others in company.

The lifebuoy should be promptly dropped and as close to the man as possible without risk of dropping it on top of him. The lifeboat should be manned and lowered. The signalman should at once go aloft, if possible, and keep his eye on the man. The way of the ship should be checked immediately the man is clear of the stern. The lifeboat after having been slipped pulls back towards the man, being guided by the signalman, provided he has succeeded in keeping the man or lifebuoy in sight. The boat can be slipped under ordinary circumstances with reasonable

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safety when the speed of the ship has been reduced to about 5 or 6 knots.

This is all perfectly simple if the weather is fair and the sea such that no manœuvring of the ship is necessary to lower the boat; if the sea is such as to endanger the crew, the officer in charge must be guided by circumstances. There can be no question that in weather too heavy to admit of lowering a boat, the one method that can give hope of saving the man is to turn round and attempt to pick him up with the ship.

NOTE.—A full explanation of the duties of the officer of the watch in the event of a man falling overboard will be found in Vol. II.

KISBIE LIFEBUOY.

Is a small circular buoy, with beckets round it to hang on by when there is more than one person supported by it.

These buoys are distributed round the upper deck of a ship, hung in conspicuous places, ready for use at the shortest notice.

At the alarm being given "Man overboard," one of these buoys is immediately thrown to his relief.

Care should be taken not to throw it at random or in a wild way, merely for the sake of pitching it overboard without any regard to the position of the man in the water.

First ascertain where the man is, and then throw it as near him as possible; if he has fallen from forward, by running aft you will, in all probability, be able to throw it in advance of the man in the water and be the means of saving him.

The best position for one man to keep himself afloat by a Kisbie's lifebuoy is to slip it over his head, and rest his arms over it on either side; in this position, by keeping himself perfectly steady, he will float for any length of time, until a boat can be sent to pick him up.

Night Life Buoy.

The Night Life Buoy consists of a yellow pine-wood cross with a hollow copper globe at the end of each arm. In the older pattern buoys, which floated perpendicularly in the water, an iron **T**-shaped foot rest was attached, and slided out from the buoy when it was let go, and hung downwards in the water. The idea was that a man should stand on the **T**-shaped foot rest, and hold on by his

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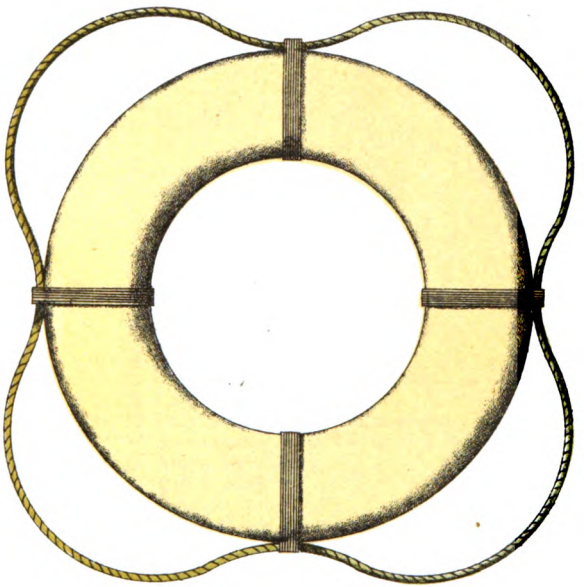
KISBIE LIFEBUOY.



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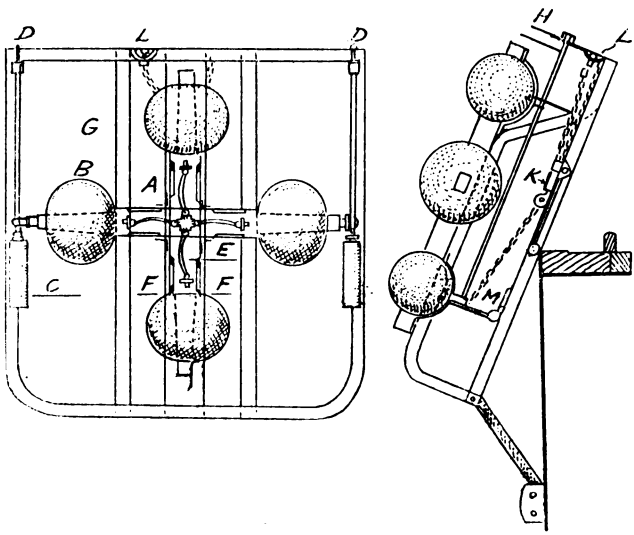
[*To face page* 364.

NIGHT LIFE BUOY.



A Cross Arms (yellow pine).
B Copper Globes.
C Cylinders for Calcium Lights.
D Extracting Rods.
E Galvanised F.S.W. Man-ropes.
F Receptacles for Whistle and Refreshment.
G Angle Bar Slides.
H Guide Rod.
K Trigger.
L Metal Knob for releasing Trigger.
M Hinge to take Weight of Buoy.

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arms to the pine-wood cross. The later pattern buoys float horizontally in the water, and have no foot rest. Galvanised F.S.W. man-ropes are fitted across the arms for holding on by. Two tubes on swivel brackets are secured to two opposite globes, having at the lower end a lead-weighted cylinder into which is placed the calcium light. When not in use the light is sealed by a lid, and an extracting rod passes down the tube and is screwed into a socket on the lid. On being let go the buoy slides down into the water, the extracting rods remaining behind and therefore pull the socket out of the lid of each calcium light; this allows the water to enter and ignite the phosphide of calcium, and the smoke and flame comes out at the top of the tubes which are kept in an upright position by the lead weight in the bottom of the cylinders. The lights burn for about 30 minutes. Small flags are attached to the tubes to assist in seeing the buoy in daylight. A spirit ration and a whistle are carried in recesses in one of the globes.

Life-Saving.

(*As taught by the Royal Life Saving Society.*)

In attempting to rescue a drowning person it must be remembered that the rescuer is at an advantage, and if he only retains his presence of mind he should have no difficulty in effecting a rescue. If, however, he should be unacquainted with the proper methods of rescue and release, great caution should be exercised.

The following rules should be observed—special attention being paid to the method of resuscitation.

Methods of Rescue.

There are five practical methods of carrying a person in the water, and those who are ignorant of what to do in cases of emergency can, in the course of ten or twelve lessons, become thoroughly proficient and able to render valuable aid in saving life without risk or danger to themselves. The methods are as follows:—

(1) When the drowning person is not struggling turn him on his back, place your hands on either side of his face. Then lie on your back, hold him in front of you, and swim with the back stroke, taking care to keep his face above the water.

(2) In case of struggling, which renders the drowning person difficult to manage, turn him on his back as before, and take a firm hold of his arms just above the elbows. Draw his arms upwards at right angles to his body and

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swim with the back stroke. This hold will put the drowning person under the control of the rescuer, and prevent him from turning round, clutching, or even struggling.

(3) If the arms be difficult to grasp, slip your hands under the armpits of the drowning person and place them on his chest or round his arms, raise them at right angles to his body, and then lie on your back and swim with the back stroke.

(4) To render assistance to a swimmer attacked by cramp, or exhausted, as well as to those in danger of drowning who may be obedient and remain quiet, the person assisted must place his hands on the rescuer's shoulders close to the neck, with his arms at full stretch, and lie on his back perfectly still, with the head held well back. The rescuer being uppermost, and having arms and legs free, swims with the breast stroke. This is by far the easiest method, and without undue exertion a person can be carried a much longer distance than by any other method.

(5) Another method of rescuing a person when passive is to hold him with one arm placed over one of his shoulders or under one of his arms, with your hand under the opposite armpit, or holding him by his clothes, thus leaving your other arm free with which to propel yourself. This method will be useful to over-arm swimmers as well as to back-stroke swimmers, for although the rescuer may be partially on his back, he will be able to use either the over-arm or the back-stroke kick. In order that the rescuer shall not be obliged to reverse his stroke, he should make use of his usual over-arm for the purpose of holding the drowning person.

Methods of Release.

The following are the three methods recommended for releasing one's-self from the clutch of a drowning person :—

(1) If the rescuer be held by the wrists, he must turn both arms simultaneously against the drowning person's thumbs, and bring his arms at right angles to the body, thus dislocating the thumbs of the drowning person if he does not leave go.

(2) If clutched round the neck he must take a deep breath and lean well over the drowning person, at the same time place one hand in the small part of his back, raise the other arm in line with the shoulder, and pass it over the drowning person's arm, then pinch the nostrils

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close with the fingers and at the same time place the palm of the hand on the chin, and push away with all possible force. The holding of the nose will make the drowning person open his mouth for breathing; being under water choking will ensue, and the rescuer will gain complete control.

(3) If clutched round the body and arms or round the body only, the rescuer must lean well over the drowning person, take a breath as before, and either withdraw both arms in an upward direction in front of his body, or in accordance with the instructions for releasing one's-self if held round the neck. In either case place the one hand on his shoulder, and the palm of the other hand against his chin, at the same time bring the knee up against the lower part of his chest, and then by means of a strong and sudden push stretch the arms and legs straight out, throwing the whole weight of the body backwards. This sudden motion will break the clutch and leave the rescuer free.

Treatment of Apparently Drowned

When a person is lifted out of the water in an apparently drowned condition, there must be no loss of time in attempting restoration. The means used to restore life must be carried out with caution, perseverance, and continuous energy, as life has, in many cases, been restored after long hours of unceasing work.

Immediately on removal from the water, and if breathing has ceased, place the patient face downwards on the ground, clear his throat, then, without stopping to remove clothing, commence artificial respiration, *as every instant of delay is serious.*

Avoid rough usage, especially twisting or bending of limbs, and under no circumstances hold the patient up by the feet.

In all cases send for medical assistance as soon as possible.

In the event of respiration not being entirely suspended when a person is lifted out of the water, it may not be necessary to imitate breathing; in that case he may be placed upon his side and natural respiration may be assisted by the application of an irritant substance to the nostrils and tickling the nose. Smelling salts, pepper, or snuff may be used.

To effect artificial respiration put yourself astride or on one side of the patient's body, in a kneeling position, facing his head. (*See* diagram 3.) Placing your hands

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flat in the small of his back, with the thumbs nearly touching and the fingers spread out on each side of the body over the lowest ribs, lean forward, and steadily allow the weight of your body to fall over upon them, and so produce a firm downward pressure, which must not be violent.

By this means the air (and water, if there be any) is driven out of the patient's lungs. Immediately thereafter swing backward, rapidly releasing the pressure but without lifting the hands from the patient's body. Repeat this forward and backward movement (pressure and relaxation of pressure) every four or five seconds. In other words, sway your body forward and backward upon your hands twelve to fifteen times a minute, without any marked pause between the movements.

By these means an exchange of air is produced in the lungs similar to that effected by natural respiration: every pressure forces air out of the chest, every relaxation of pressure causes it to pass in.

This procedure must be pursued until natural respirations are resumed. If they are resumed and, as sometimes happens, again tend to fail, the process of artificial respiration must be resorted to as before.

Whilst the operator is carrying out artificial respiration others may, if there be opportunity, busy themselves with applying hot flannels to the limbs and body, and hot bottles to the feet, or promote warmth by friction; but no attempt should be made on the part of the operator to remove the wet clothing or to give any restoratives by the mouth until natural breathing has recommenced.

When natural respiration is once established, cease to imitate the movements of breathing. Then you may turn the patient face upward and proceed with the treatment for the promotion of warmth and circulation.

Friction over the surface of the body must be resorted to, using handkerchiefs, flannels, &c. By these means the blood is propelled along the veins towards the heart.

The friction along the legs, arms, and body should all be towards the heart, and continued after the patient has been wrapped in blankets or some dry clothing.

As soon as possible after breathing has been established, remove the patient to the nearest house, and further promote warmth by the application of hot flannels to the pit of the stomach, and bottles, or bladders of hot water, heated bricks, &c., to the armpits, between the thighs, and to the soles of the feet. If there be pain or difficulty in breathing, apply a hot linseed-meal poultice to the chest.

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On the restoration of life, a teaspoonful of warm water may be given; and then, if the power of swallowing has returned, very small quantities of beef-tea or coffee administered, the patient kept in bed, and a disposition to sleep encouraged.

Watch the patient carefully for some time to see that breathing does not fail.

If the patient has been carried to the house, be careful to let the air circulate freely about the room, and prevent crowding round the patient.

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RESUSCITATION DRILL.

THE SCHÄFER METHOD.

The object of this drill is to teach the treatment for restoring suspended breathing.

Note.—One or more ranks may be formed, according to the number of members of the class and the space at the disposal of the Instructor, who should take care to leave a clear space of at least six feet between each rank.

When it is necessary to cover the floor in order to protect the clothing of the members of the class, the instructor will direct numbers "one" to place a mat or towels, covering a space of about 6 ft. by 1 ft. 6 in. over the place taken up by each number "one" at the right side of numbers "two," such mat or towels to extend about 3 ft. 6 in. to the front of the rank. This having been completed, numbers "one" will resume their places in the rank, and then the Instructor will explain the object of the drill, the duties of numbers "one" and "two," and the Resuscitation Drill will be proceeded with as follows :—

Position.—On the word "Position," number "one" will go down, first on the right, then on the left knee, fall forward on to the hands, and lie down face downward, resting the left side of the face on the mat. (*See* diagram 1.) Number "two" will then go down on both knees, at the left side

Diagram 1.

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of number "one," facing to the front, and will place the hands in the small of the back of number "one," with thumbs nearly touching and fingers extended on each side of the body. (*See* diagram 2.)

Diagram 2.

One.—On the word "One," number "two" will lean forward, steadily allowing his weight to fall over upon both hands, slowly and without effort, so that the lower part of the body of number "one" is compressed against the floor, while the body of number "two" inclines forward over his own hands. (*See* diagram 3.)

Diagram 3.

Two.—On the word "Two," number "two" will swing quickly backward, releasing all pressure, but without lifting his hands from the patient's body. (*See* diagram 2.)

Continue.—On the word "Continue," the movements "one" and "two" must be repeated in regular time, at the rate of about twelve to fifteen times a minute.

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Halt.—On the word "Halt," the movement "two" must be completed, and then number "two" will bring his hands from the patient's body smartly to his own sides and kneel at attention. (*See* diagram 4.)

Diagram 4.

Promote Warmth.—On the word "Warmth," number "two" will rub the patient along his back, the sides of his body, inside his legs and inside his arms; the rubbing must always be towards the heart.

Re-Form.—On the word "Re-form," numbers "one" and "two" will spring to their feet, resume their original positions in line, face the front, and stand at "Attention."

Change—Ranks.—On the word "Ranks," number "two" will step back one pace with his left foot, take a pace to the right with the right foot, one to the front with the left foot, and take up his position in the place of number "one"; as number "two" steps back, number "one" will take a side pace to the left, and thus occupy the position vacated by number "two."

Note.—By the "Change-Ranks" the patient becomes the operator or number "two."

Immediately the order "Change-Ranks" is completed the Instructor will give the order "Number," and repeat the Drill from the order "Position," so that each member performs the same duties.

On completion of the Drill, the Instructor may either repeat it or conclude the lesson by the order "Dismiss."

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Other valuable information on life-saving and resuscitation can be learnt from the Life Saving Society's handbook, price 1s.

Hints to Bathers.

Avoid bathing in quiet or secluded spots, as should an accident occur, and no help be near, a very obvious state of matters may follow. The most suitable time to bathe is about an hour or two before a meal, when food taken at a previous meal will have become partially digested. On no account bathe shortly after a hearty meal, when exhausted from vigorous exercise, when the body is cooling after perspiration, nor, on the other hand, when shivering. Do not stand or wait at the water's edge until the warmth of the body has passed off. Cleanse the mouth and nostrils before entering the water and breathing will then be easy, natural, and unimpeded. Do not gasp or catch the breath suddenly or spasmodically, or make short inhalations or expirations. Breathe freely, naturally, and regularly. Persons unaccustomed to cold-water bathing should not stay in too long at first. Avoid bathing altogether in the open air, if, after a short time in the water, it causes a sense of chilliness with numbness of the hands and feet. Persons subject to giddiness or faintness, or who suffer from palpitation or other troubles of the heart, should not bathe without first consulting a physician.

Those subject to ear-ache, deafness, or running from the ears, should carefully plug their ears with greased cotton-wool or cover with waterproof caps before entering the water. Under such circumstances deep diving should be avoided.

The good effects of bathing are in proportion to the vigour of the reaction experienced after leaving the water.

In cases of accidental immersion it should be borne in mind that weight of clothes will not hurriedly drag one under water, nor cause one to sink sooner than if undressed, in fact the air in one's clothes will help to buoy up as well as enable the immersed to resist the effects of cold water for a longer time than if quite naked. Of course, one cannot swim fast with clothes on.

If taken with cramp turn on the back, rub and stretch the affected limb. If seized in the leg, turn up the toes, straighten the leg, and stretch the leaders, apply friction, and kick the surface of the water, until the muscles relax.

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Meteorological Instruments.

The meteorological instruments usually supplied to a large ship are :—

One mercurial barometer.
Two aneroid barometers.
Six thermometers.
Two maximum thermometers.
Two minimum thermometers.

A Barometer is an instrument which is governed entirely by the pressure of the atmosphere, and, in consequence, shows at once when that pressure is changing. If the pressure at one place on the earth's surface be greater than at another, the air has a tendency to move from the place where the pressure is greater towards that where it is less, and thus "wind" is caused. A change of weather comes almost always with a change of wind, and on the extent of this change depends whether the new wind is warmer or colder, damper or drier, than that which has been blowing.

In general, if the level of the mercury in the barometer continues steady, settled weather may be expected, but when it is unsteady a change must be looked for.

A sudden rise of the barometer is very nearly as bad as a sudden fall, because it shows that the atmospheric equilibrium is unsteady.

A Mercurial Barometer in its simplest form is merely a glass tube closed at one end and filled with mercury, which is then boiled in order to extract any minute quantities of air which may be adhering to the sides of the glass, after which it is inverted and its open end placed below the level of the surface of the mercury in a small cistern. The mercury now descends in the tube until the weight of the column is balanced by the pressure of the atmosphere on the mercury in the cistern, thus affording a correct measure of such pressure. By means of a scale of inches, whose zero is level with the surface of the mercury in the cistern, the exact height of the column can be recorded. Certain corrections have to be made to the readings as shown by the barometer, in order to make comparisons with other barometrical observations.

The mercurial barometer is used as the standard on board, though it differs materially in construction from the standard on shore, the two chief differences being :—

(1) The bore of the marine instrument is contracted for the greater part of its length in order to prevent an up-and-down motion of the mercury (technically called "pumping"), due to the rolling and

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pitching of the ship; this contraction, however, increases the friction of the mercury in the tube, and consequently makes the marine instrument somewhat slower in recording a change of pressure.

(2) The second important difference is that the zero point in all standard barometers from which the graduation commences is a fixed ivory point depending from the top of the cistern in the shore instrument, and provision is made for altering the capacity of the cistern so as to enable the level of the mercury to be exactly set at this point just previous to an observation being made, thus cutting out the connection for "capacity," which is allowed for when reading a marine barometer, but the necessity for applying an actual correction in the marine barometer is avoided by manipulating the scale in such a manner as to give a correct difference between the level of the mercury in the cistern and the height recorded. This is done by the manufacturers. It should be remembered that when reading the barometer the zero of the vernier should always be made to coincide with the highest part of the curve of the mercury column.

Great care should be exercised in handling this instrument, as a sudden lowering of the top generally means breakage, owing to the vacuum at the top of the mercury permitting it to fall practically as if it was a solid metal rod; barometers should be inverted very slowly, and packed with their cisterns ends up.

A place should be chosen for it; suspension low down, and, if possible, near to the centre of gravity of the ship, out of the way of traffic, and in as uniform a temperature as possible.

How to read the Barometer.

Turn the vernier wheel until the lower edge of the former is level with the top of the mercury. (Great care should be taken to acquire the habit of reading with the eye exactly on a level with the top of the mercury.) Then—

(1) Note the scale line next below the level of the top of the mercury column, as shown by the lower edge of the vernier. (This in the figure is 29·40.)

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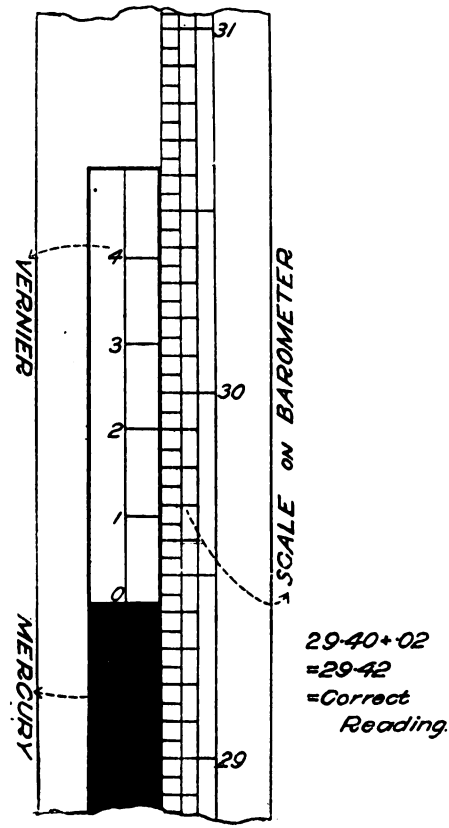

Sketch showing Scale and Vernier on a Mercurial Barometer.

(2) Look at the vernier, and note that line which is in one and the same direction with a line on the scale. (This in the figure is the second line from the bottom of the vernier, and represents two hundredths of an inch, or ·02 of an inch.)

(3) Add the two together, which will give the correct reading. (This in the figure is 29·40

·02

29·42)

An Aneroid Barometer depends for its indications on the movements of the top of a metal drum which is made very thin and corrugated, after which it is partially exhausted of air, thus making it very susceptible to the slightest changes in the external pressure. This top is connected to a pointer by means of very delicate mechanism,

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which has the effect of greatly magnifying its movements. This pointer can be set at any pressure by means of a screw at the back of the instrument, and, as owing to its extreme delicacy, the mechanism is always somewhat liable to derangement, the reading of the instrument should frequently be compared with that of the mercurial barometer, and if any difference is noted it should be set to correspond with the latter instrument.

The great advantage of the aneroid is its convenient size, and also the rapidity with which it will show any change of pressure. Also it can be kept in the chart-house immediately under the eyes of the officer of the watch.

A Thermometer is an instrument for measuring the temperature. It consists of a closed glass tube with a hair-like bore, terminating in a bulb at one end. The bulb and part of the tube contains mercury, the remainder of the tube being a vacuum. A graduated scale is attached.

The thermometers used for sea temperature are enclosed in metal cases to prevent breakage. The water should be drawn clear from any discharge from the ship, the nearer the bow the better, and the thermometer should be immersed for several minutes. If a canvas bag is used it should not be placed in a draught, as evaporation will materially lower the temperature.

A Maximum Thermometer differs only in construction to an ordinary one in that the zero of graduation is at the end of the tube farthest away from the bulb, and it also has a small contraction in the bore just above the bulb; the effect of this contraction is to largely increase the friction set up between the mercury and the sides of the bore, and therefore to prevent any passage of mercury except under considerable pressure. Its action depends on the difference of the forces caused by gravity, and the expansion of mercury caused by an increase of temperature, the latter being largely in excess of the former. Supposing the instrument to be suspended vertically, bulb end up, and that the temperature remains uniform at freezing point, the mercury in the bulb will remain there, as the force of gravity is not sufficient to overcome the friction at the point of contraction. If the temperature decreases, still nothing happens, except that a small space is formed in the bulb due to the contraction of the mercury there. On the other hand, if the temperature increases, the mercury expands and refills this small space, after which the surplus portion is forced through the contraction, and falls to the bottom of the bore, which it fills by an amount depending on the rise of temperature, and which amount can be read off on the scale.

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When re-setting, all that is necessary is to swing the instrument bulb down; this force, together with that of gravity, enabling the mercury at the bottom of the bore to overcome the friction in the contraction, and thus re-enter the bulb. After being re-set and suspended bulb up it should read the same as an ordinary thermometer observed at the same time.

A Minimum Thermometer differs from an ordinary one in that alcohol is substituted for mercury on account of its transparency and non-liability to freeze; also a small black glass index, shaped like a dumb-bell, is inserted into the column of liquid in the bore of the tube. Its action depends on the power of cohesion of the particles forming the surface of any liquid which is illustrated by the familiar experiment of floating a needle on the surface of water in a cup. To set the instrument it should be held with the bulb inclined upwards, the index will then slide down until one end comes to the surface of the liquid in the bore, through which it is unable to break, and this end should show the then temperature of the air. Supposing that the instrument is placed horizontal, and that the temperature rises, the index will remain stationary, and the liquid flows past it up the bore, but if, on the contrary, the temperature falls, the index is carried towards the bulb, as soon as the surface of the liquid in the bore touches it, its movement being continued until the temperature stops falling.

Winds.

The primary cause of all winds is a difference of temperature; which, in turn, owing to hot air rising, causes a difference in pressure over two areas, and the air flows from the regions of high pressure to the regions of low pressure.

The hot air over the equator rising causes the air to flow towards the equator from the high latitudes.

If the air remained at rest, relative to the earth's surface, wind would not be felt; but it is felt at once if the air is driven to a latitude having either a faster or slower revolutionary motion.

At the equator the earth's rotation is about 1,000 miles an hour, and at the poles nil. The air from the higher latitudes, where the earth's velocity is comparatively small, flows to the lower latitudes, where the velocity is great, and is deflected from East to West, or in a direction opposite to the earth's rotation, hence trade winds blow roughly from N.E. and S.E.

Wind systems are either " cyclonic " or " anti-cyclonic."

[*Continued on page* 381.]

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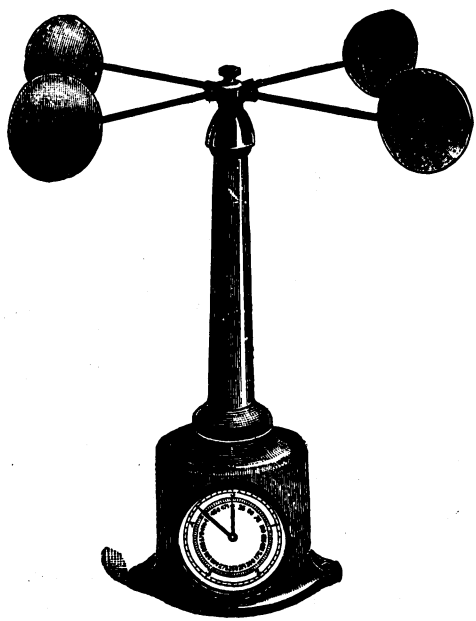
TABLE SHOWING THE FORCE OF THE WIND AS REGISTERED BY BEAUFORT'S NOTATION.

Miles per Hour registered by Anemometer.	Force.
0 to 3	Calm.
8 to 13	Light airs 1 to 2.
18	3
23	4
28	5
34	6
40	7
48	8
56	9
65	10
75	11
90	12

ANEMOMETERS.



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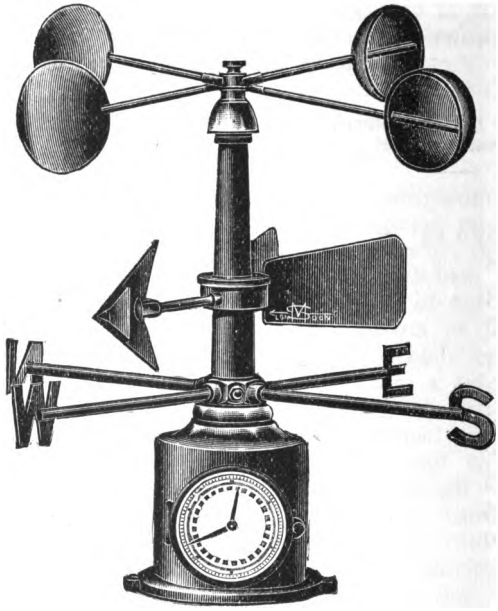

(*Note.*—These anemometers are obtainable from Short and Mason, Macdonald Road, Walthamstow.)

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Cyclonic Winds are those which blow round an area of low pressure, and generally travel quickly, and are accompanied by strong winds. They blow spirally inwards round the area of low pressure; against the hands of a watch in the northern hemisphere, and with the hands of a watch in the southern hemisphere.

Anti-cyclonic Winds are those which blow round an area of high pressure: they travel slowly, and are generally accompanied by fine and settled weather. They blow spirally outwards from the area of high pressure; with the hands of a watch in the northern hemisphere, and against the hands of a watch in the southern hemisphere.

If desirous of finding out the direction of the area of low pressure or that of high pressure, the following law should be remembered:—

"Stand with your face to the wind and the area of low pressure will be on your right hand in the northern hemisphere, and on your left hand in the southern hemisphere."

Wind is said to "veer" if it shifts in the direction of the hands of a watch, and to "back" if it shifts in the opposite direction.

Force of the Wind.—An instrument called an anemometer (a sketch of which is given) registers the velocity of the wind. The instrument is placed in the air, with the fan-wheel facing the wind. The velocity can then be read from the dial by noting the difference in the readings between times given by a stopwatch. The pressure in pounds per square foot is given by $P = \cdot 003\ V^2$ where V is miles per hour. There are several forms of anemometers, varying in size from a pocket edition upwards.

Measurements.

Cable.—As a measure used in marine surveying is one-tenth of a nautical mile, which is estimated roundly at 6,000 feet. Thus, 1 cable = 600 feet = 100 fathoms.

Chain.—The unit employed in the actual measurement of lengths by surveyors. The land surveyor's chain consists of 100 links = 4 poles = 22 yards = 66 feet. The marine surveying chain is 100 feet.

Degree.—Is the angle subtended at the centre of a circle by an arc equal to the 360th part of the circumference. A degree is subdivided into 60 minutes, and each minute into 60 seconds.

A degree of longitude is equal to 4 minutes of time.

Earth.—The circumference of the earth at the equator is little less than 25,000 miles.

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Fathom.—Measure of length and equal to 6 feet. Soundings are reckoned in fathoms.

Knot.—The common term for a nautical mile used at sea = 6,080 feet.

League.—Three nautical miles.

Mile.—The common and authorised land mile used by the English = 1,760 yards = 5,280 feet.

Sound.—At an average temperature of 62° travels at the rate of 1,125 feet per second.

Time.—A definite portion of duration. It is marked in a general manner by the recurrence of striking natural phenomena, such as the alterations of light and darkness, and the succession of the seasons. Thus the two natural measures of time are the "day," or period of the earth's rotation on her axis, and the "year," or period of the earth's revolution in her orbit.

Common time is reckoned from an "initial instant" or "epoch," independent of local situation, which is the same for all the inhabitants of the earth.

Local time is reckoned at each particular place from an epoch determined by local convenience, such as the transit of the sun's centre over the meridian of the place.

Greenwich time is the mean solar time of Greenwich.

Ship time is the mean solar time at the place where the ship happens to be.

In East longitude it is evidently before Greenwich time, and in West longitude behind, every 15 degrees of longitude making a difference of one hour.

Provisions.

Wet provisions are: Salt beef, salt pork, suet, vinegar, lime-juice, and rum.

Dry provisions are: Biscuit, beans, peas, flour, raisins, tea, coffee, chocolate, sugar, rice, oatmeal, mustard, pepper, preserved meats, &c., jam, milk.

Provisions are supplied to H.M. ships as follows:—

Dry Provisions.

Biscuit supplied in tin-lined cases –	– 40, 80 lbs.
Sugar supplied in wood drums –	– 100, 200 lbs.
Chocolate supplied in wood cases –	– 50, 100 lbs.
Tea supplied in wood cases –	40, 50, 60, 80, 100 lbs.
Raisins supplied in wood cases –	– 56 lbs.
Split peas supplied in casks –	– 100, 200 lbs.

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Haricot beans, Marrowfat peas	in casks of 80 and 160 lbs.
Flour supplied in sacks	140 lbs.
Rice supplied in casks	100, 170 lbs.
Preserved Mutton, in tins in cases	36 lbs.
,, Beef ,, ,,	36 lbs.
Salmon in tins in cases	48 lbs.
Rabbit ,, ,,	48 lbs.
Corned Beef, in tins in cases	36 lbs. and 72 lbs.
Mustard, Pepper	cases containing 50 lbs. supplied in 1, 5, and 10 lb. canisters.
Oatmeal, in casks	80, 170 lbs.
Jams, in tins in cases	48 lbs.
Coffee, ,, ,,	56 lbs.
Milk, ,, ,,	36 lbs.
Soap, in iron-bound cases	100 lbs.
Tobacco, in cases	50, 100 lbs. (leaf), also in ½ lb. tins of cut tobacco, 45 in a case.

Wet Provisions.

Rum, casks (chime painted red)	10, 20, 25, 30, 35 gallons.
Vinegar, casks (chime painted white)	10, 25 ,,
Salt Pork, casks	100, 200 lbs.
Salt Beef, ,,	100, 200 lbs.
Suet, cases, refined	48 lbs.
Salt, wood drums	112, 224 lbs.
Lime-juice, wood cases	40 lbs.

Provisions are stowed in the holds and provision rooms, so that each kind can be got at in due proportion without breaking bulk.

Clothing.

Hats and caps supplied in wood cases.
Boots and shoes ,, casks.
Latrine paper and beds supplied in bags.
Ditty boxes and cap boxes ,, cases.
Hat ribbons supplied in cardboard boxes.
Badges, buttons, &c., supplied in packages.
Seamen's clothing supplied in wrappers.
Marines' ,, ,, casks.
Library (officers' and seamen's) supplied in cases.

Implements and Mess Utensils.

Officers' mess traps supplied in cases and casks.
Chief petty officer's and seamen's mess traps supplied in cases.

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Sick berth implements supplied in cases.
Wine and medical comforts supplied in cases.

Stowage of Holds.

Salt meats and suet are stowed alternately.

Oldest provisions are always stowed on top of new ones.

Wet provisions are stowed in different provision room to dry provisions.

Biscuit is stowed in the bread room.

Clothing is stowed in the slop room.

Rum is stowed in the spirit room.

Tobacco and soap are stowed in the dry provision room.

Fresh water is stowed in tanks built into the ship for that purpose.

Casks are stowed bung up, bilge free, and lying fore-and-aft.

The bung of a cask is between the rivets of any two opposite hoops.

The bilge of a cask is the largest circumference.

The staves of a cask are the pieces of wood forming the sides.

The chimes of a cask are the projection of the staves beyond the head.

Casks are said to be stowed "*Aburton*" when placed athwartships and in line with the beams.

Bedding a Cask is putting dunnage around it to keep it in its place.

Chime to Chime.—When two casks are stowed end to end.

The *Contline* is the space between the bilges of the casks stowed side by side.

Bung up and bilge free.—When casks are resting on their beds, with the lower part of their bilges just clear of the bottom of the provision room.

Preparing for Provisioning.—Boat ropes and fenders should be prepared ready for lighters coming alongside, gangway or other whips rove, steam on the crabs (when so fitted), mats placed for receiving the hoists, hatches that are to be used cleared away, tackles hooked, and mats placed round the coamings and on the deck where the gear will be lowered to, slings provided at the hatches; where it is necessary to transport casks from one compartment to another, inclines should be fitted and placed at the doors. It will be found of great assistance in provisioning to have

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made three or four hempen nets (similar to those used in victualling yard lighters), each net would be capable of taking about a dozen cases, and would save considerable time in slinging.

Identification Marks.

Casks have two bands of paint, one at each end, between the hoops, and a distinguishing line of the same colour across their heads.

Cylindrical cases are marked in the same manner as casks. All other packages have a band of paint on the length of each side and end, so that the lines do not cross each other.

The distinctive colours are as follows :—

Naval ordnance stores :—

- Non-explosive – A broad dark blue band.
- Torpedo stores – Two narrow blue bands and the letter **T** stencilled in blue on them.

Naval stores – Yellow.

Victualling stores – Green.

Medical stores – Marked with Geneva cross badge and the letter **N** to distinguish them from similar Army stores.

Distinguishing Colours for Oil Drums.

Description of Oil, &c.	Distinguishing Colour for Drum.	Remarks.
Linseed, raw	Grey	Description of oil, quantity, &c., is stencilled on one end of drum.
,, boiled	White	
Mineral lubricating, "ordinary."	Yellow	
Olive	Blue	
Rapeseed, for lighting	Brown	Description of oil, quantity, &c., is stencilled on both ends of drum.
Mineral sperm	Brown	
,, "Special"†	Green	
,, non-freezing	Black	
Neatsfoot	Black	
Train	Black	
Sperm	Black	
All other descriptions of lubricating, lighting, &c., oils.	Black	†There are several descriptions of Special Mineral Oil, and full particulars of these descriptions are stencilled on drums.
Mineral tar	Blacked with coal tar.	
Vegetable tar (when issued to ships).	Blacked with coal tar with white ring.	

NOTE.—The distinguishing colour for casks, &c., containing inflammable liquids of all descriptions is RED.

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Weights and Measures.

Division of the Circle.

60 Seconds	–	–	–	1 Minute.
60 Minutes	–	–	–	1 Degree.
360 Degrees	–	–	–	1 Circumference.
4 Minutes of Time	–	–	–	1 Degree of Longitude.
15 Degrees	–	–	–	1 Hour.

Time.

60 Seconds	–	–	–	1 Minute.
60 Minutes	–	–	–	1 Hour.
24 Hours	–	–	–	1 Mean Solar Day.
7 Days	–	–	–	1 Week.
28 Days	–	–	–	1 Lunar Month.
12 Calendar Months (365 Days)				1 Civil Year.
365 Days, 5 Hours, 48 Minutes, 47·6352 Seconds			–	1 Solar Year.

WEIGHTS.

Troy.

24 Grains	–	–	–	1 Pennyweight.
20 Pennyweight		–	–	1 Ounce.
12 Ounces	–	–	–	1 Pound.

NOTE.—Used for precious metals.

Avoirdupois.

24·34375 Troy Grains		–	–	1 Drachm.
16 Drachms	–	–	–	1 Ounce.
16 Ounces	–	–	–	1 Pound.
14 Pounds	–	–	–	1 Stone.
28 Pounds	–	–	–	1 Quarter.
4 Quarters	–	–	–	1 Hundredweight.
20 Hundredweights		–	–	1 Ton.

NOTE.—Used for all ordinary goods. The Pound Avoirdupois consists of 7,000 Grains Troy.

Ale Measure.

4 Gills	–	–	–	1 Pint.
2 Pints	–	–	–	1 Quart.
4 Quarts	–	–	–	1 Gallon.
9 Gallons	–	–	–	1 Firkin.
18 Gallons	–	–	–	1 Kilderkin.
36 Gallons	–	–	–	1 Barrel.
54 Gallons	–	–	–	1 Hogshead.

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Dry Measure.

2	Imperial Gallons	–	–	1 Peck.
4	Pecks	–	–	1 Bushel.
8	Bushels	–	–	1 Quarter.

Measure of Surface, or Square Measure.

144	Square Inches	–	–	1 Square Foot.
9	Square Feet	–	–	1 Square Yard.
30¼	Square Yards	–	–	1 Square Pole.
40	Square Poles	–	–	1 Square Rood.
4	Roods (4,840 Sq. Yards)		–	1 Statute Acre.
640	Acres	–	–	1 Square Mile.

Measure of Length.

12	Inches	–	–	1 Foot.
3	Feet	–	–	1 Yard.
5½	Yards	–	–	1 Pole, Rod, or Perch.
40	Poles	–	–	1 Furlong.
8	Furlongs (1,760 Yards)		–	1 Mile.
3	Miles	–	–	1 League.

Miscellaneous.

6	Feet	–	–	1 Fathom.
100	Fathoms	–	–	1 Cable.
10	Cables	–	–	1 Nautical Mile.
1	Nautical Mile or Knot		–	6,080 Feet.
12½	Fathoms	–	–	1 Shackle or length of Cable.

SEA TERMS.

Aback.—The position of the sails when their surfaces press against the mast.

Abaft.—Is on the after side of, the after part, or stern of a ship.

Abandon.—To leave the ship and take to the boats.

Abeam.—In a line at right angles to the ship's length side by side.

Aboard.—Inside a ship.

Above Board.—Over the deck. A common phrase for honest, open dealing.

A-Box.—When the yards are braced in opposite directions.

About.—On the other tack.

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A Cockbill.—An anchor when hanging by only the ring. The position of the yards when topped up at an angle with the deck.

Adrift.—Broken from moorings. Driven at random by tide and wind.

Afloat.—Borne on the water. Floating on the surface.

Afore.—In front.

Ahead.—In advance. Any object before the ship.

A-Lee.—Position of the helm when placed in the opposite direction from that in which the wind is blowing. To leeward.

All in the Wind.—When too close to the wind so that the sails shake.

Aloof.—To keep at a distance.

A.M.—Ante-meridian. Before noon.

A-Peak.—In shortening in a cable, when a ship is drawn entirely over her anchor.

A-Stay or " Short Stay."—The anchor is said to be astay or short stay when the cable is in a line with the forestay.

All-A-Taut.—Is a ship fully rigged and everything in its place.

Athwartships.—At right angles to the keel.

Athwart-hawse.—Lying across the bow.

Avast.—To hold fast. Hence the term: avast heaving.

A-Weather.—When the helm is placed in the direction the wind blows.

Awash.—Level with the surface of the water.

Aweigh.—When the anchor is broken out of the ground.

Bare Poles.—Having no sail set.

Batten Down.—Securing the hatches by means of gratings and tarpaulins, which are kept in place by battens being secured over them.

Bear Up.—To keep further away from the wind.

Beating.—Tacking towards the direction of the wind.

Beneaped or Neaped.—When the tide does not rise high enough to float a vessel she is said to be beneaped.

Bight.—Any part of a rope that is folded may be called the bight, except the ends.

Bilge.—That part of the ship near the keel. If a ship's bottom is stoved in, she is said to be bilged. Bilge is also the largest part of a cask.

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Bitter.—Any turn of the cables round the bitts is said to be a bitter. Singing songs on the forecastle is termed "Fore Bitters."

Blue Peter.—A blue flag with a white centre hoisted at the masthead signifies the vessel is about to sail.

Bolt Rope.—The rope round a sail to which the canvas is sewn. (*See* page 101.)

Bonnet.—An additional piece of canvas laced on to a sail or hatchway cover. A plate bent to the form of a bonnet and secured to the cover of the navel pipes. The front of the bonnet is closed in by a sliding shutter which fits around the link of the cable and prevents water going below.

Bottomry.—The hull of a ship pledged as security for a loan.

Bow-fast.—A warp or hawser for holding the vessel by the bow.

Bowse or Bouse.—To pull. Hauling with a will on a rope. "Bowse to the compressor," to haul on the tackle until the compressor nips the cable.

Box the Compass.—To name the points of the compass in regular order.

Brace of Shakes.—An expression indicating a smart movement.

Break Bulk.—To commence unloading a full hold.

Breast-fast.—A fastening to keep a ship's gangway to a quay.

Breast Rope.—The part of the rope round the man in the chains whilst heaving the lead.

Bring-to.—An expression used in bending sails, or when a ship is about to anchor. To bring-to is also to attach the cable to the capstan, or a rope to a winch or purchase.

Broach To.—Coming suddenly up to the wind; it occurs when running with the wind on the quarter from bad steering, or a sea striking the stern, &c.

Broken-backed.—When a vessel or boat is so loosened in her frame as to droop at each end.

Broken Water.—When waves lose their form by breaking over reefs, rocks, or shallows, or by meeting waves from another direction, termed a cross sea.

Brought-to.—The cable is said to be brought-to when the links are lying in the sprocket of the capstan. Also when a vessel is anchored.

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Brought to his Bearings.—The conceit taken out of any-one who prides himself on great smartness or knowledge.

Brought by the Lee.—When running and the wind changes to the opposite quarter.

Bull.—Putting a small quantity of water into an empty rum cask and leaving it until it becomes grog is called bulling a cask.

Buoy Watching.—The anchor buoy being above water.

Butt-end.—The largest end of a spar.

By the Board.—Fallen overboard or over the ship's side.

By the Head.—When a vessel is deeper in the water forward than aft, she is said to be " by the head."

By the Stern.—The opposite to " by the head."

By the Wind.—Is sailing as close to the wind as possible.

Caboose.—A small house on deck.

Camel.—A hollow tank or vessel filled with water and placed under the hull of a stranded ship. It is well secured to the ship and then pumped out, the buoyancy thus added helping to lift the ship.

Can Hooks.—Slings with iron hooks at each end, used for slinging casks.

Cant-to.—Anything that does not stand square, diverging from a central line.

Capful of Wind.—A puff of wind soon passing away.

Careen.—To heel or list a vessel over on one side so as to get at her bottom. A vessel lying over when sailing on a wind is also said to be careening.

Carry Away.—To break a spar or rope.

Carry On.—To make all sail at risk when blowing fresh. To proceed.

Cast.—To pay a vessel's head off on the tack she is to sail upon.

Cat's Paw.—A light air, seen at a distance in a calm by the ripple made on the sea. Also the twist made in a rope to hook on to.

Check.—To ease a rope a little. To stop progress.

Chinse.—To lightly stop the seams of a boat with oakum.

Chock a Block.—Full up.

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Clap-on.—An order to get hold of a rope or purchase for the purpose of hauling on it.

Claw to Windward.—Beating gradually to windward. To claw off a lee shore.

Clean Full.—Although the sails are not quite close-hauled, yet they are well full.

Close-hauled.—Sailing close to the wind.

Con.—To direct the steering of a vessel.

Cordage.—A general term for rope.

Cracking On.—Having a lot of sail set.

Crank.—A vessel or boat listed over easily is said to be crank. Not stiff under canvas.

Crow's Foot.—*See* Euphroe.

Dead Light.—Shutters or coverings to open ports. Also fitted to side lights to prevent the internal lights of a ship from showing outboard.

Dead Water.—The water in a vessel's wake close to her stern.

Demurrage.—Compensation paid to the owner of a vessel when she has been detained longer than her time for unloading.

Derelict.—A vessel abandoned at sea.

Dipsy.—The float of a fishing line.

Dismantled.—Unrigged.

Dog Vane.—A small vane, made of feathers or bunting, attached to the weather shroud to show the direction of the wind.

Dowse.—To lower or let go suddenly. "Dowse the glim"—to put the lights out at once.

Draw.—Sails are said to draw when they are steady and well filled with wind. To draw a jib is to shift over the sheet.

Drive.—A ship is said to be driving when her anchors will not hold. When not under control a vessel is said to be driving to leeward.

Dunnage.—Pieces of wood, or any other substance, placed between casks to keep them steady. The battens with which a storeroom is lined.

Elbow.—There is said to be an elbow when a ship is moored and has two crosses in her cable.

End for End.—To shift a length of rope by reversing its ends.

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End on.—A vessel is said to be end on when only her bows are to be seen. An object bearing in a line with the keel directly ahead.

Euphroe or Crow's Foot.—A single block through which is rove a piece of wire fitted with clip hooks at each end. A third leg is spliced into the arse of the block. Sometimes a sister block is used through which two pieces of wire can be rove. Used for supporting the centre of an awning when there is no centre stanchion.

Eyes of Her.—The extreme fore-end of the ship near the hawse pipes.

Fag End.—When there is nothing left of the rope but the end.

Fake.—A circle or ring formed by coiling a rope.

Fane.—An ancient term for weathercock.

Fell in with.—One ship meeting another at sea.

Fetch.—To reach; to arrive at. In close-hauled sailing in the same sense that she will fetch that buoy or mark on this tack.

Fiddle.—A strip of wood fitted with six to ten sheaves through which are rove small halliards for hoisting revolution flage. Also a frame work used for hauling lower turns up between upper turns when making sword matting.

Fishing a Yard or Spar.—Strengthening by means of lashing a smaller spar firmly to it.

Flash in the pan.—A brilliant effort unsustained.

Flake.—To arrange a rope or hawser in layers so that it will run clear.

Flare.—The overhang of a vessel's upper works forward.

Flat Aback.—When the wind takes the sails well on the wrong side.

Flat Aft.—When the sheets of the fore and aft sails are hauled as taut as possible.

Flatten in the Sheets.—To haul the sheets aft.

Fleet.—To come up any tackle or purchase; to draw the blocks apart for another pull after they have been drawn together. To shift the position of, *e.g.*, "Fleet that leading block."

Flemish Coil.—To coil a rope down so as to have each flake to lay exactly outside the other, beginning in the middle.

Floating Bethel.—A ship fitted up as a place of public worship.

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Flotsam.—The cargo of a wreck that may be floating about or freed from the wreck.

Flush Deck.—When the deck has no raised or sunken part, *i.e.*, when it forms a continuous fair line from stem to stern.

Flying Light.—When a vessel has been lightened and is floating with her proper load line well out of the water.

Flying to.—When a vessel is swinging quickly towards any point.

Fly up in the Wind.—When a vessel comes up quickly head to wind.

Forereach.—Shooting ahead when going about under sail or when a boat under sail is luffed up into the wind and continues to go ahead.

Forerunner.—A warning of the approach of anything.

Forge.—To forge ahead is to shoot ahead.

Foul Anchor.—When the cable has a turn round the anchor.

Foul Berth.—When a ship has not room to swing.

Foul Bottom.—A ship's bottom is said to be foul when covered with barnacles, weed, &c. Also the bottom of the sea if rocky or unsafe from wrecks.

Foul Hawse.—If moored and the cables become crossed.

Founder.—To sink.

Free.—Sailing off the wind; not close-hauled. All clear.

French Leave.—Quitting the ship without permission, or remaining over leave.

Freshen.—Shifting the nip of any rope or cable by slackening it a little.

Full and Bye.—Sailing close to the wind but keeping everything full.

Full Due.—Anything finally set up is said to be set up for a full due.

Gang Casks.—Small casks used for watering ship in boats.

Gang Board.—A plank or planks attached to the bow of a boat to walk in or out on.

Gawky.—An awkward, clumsy youth.

Gather Way.—When a vessel begins to move through the water.

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Garland.—Display of flowers and ribbons, hung between the ship's masts, denoting one of the crew is being married.

Girt.—When a vessel is moored so taut as to be prevented from swinging.

Goring Cloths.—The side pieces of a sail.

Granny's Knot.—A term of contempt applied when a reef knot is crossed the wrong way.

Go About.—To tack.

Going Free.—Sailing with a fair wind.

Gripe.—To carry too much weather helm. A piece of wood fitted to the forefoot in wooden ships.

Gripes.—Pieces of matting fitted into thimbles and lanyards to secure a boat when hoisted at the davits.

Ground Swell.—A swell which is not caused by the wind prevailing at the time.

Ground Tackle.—A term that includes the anchoring apparatus.

Guest Warp.—A rope with Turk's head worked at intervals along it, extending from the accommodation ladder to the lower boom.

Gybe.—In a fore and aft rig, to keep the vessel so much off the wind that it comes on the lee quarter, and causes the sail to shift over.

Half an Eye.—Sharp-sighted.

Half Seas Over.—Half drunk.

Hand over Hand.—Hauling a rope quickly with alternate hands.

Handsomely.—Slowly and with care.

Handy Billy.—A small jigger.

Hanks.—Small wooden or iron hoops for confining a jib or staysail to the stay.

Harness Casks.—A large tub for containing salt meat for present use.

Heart Yarns.—The centre yarn of a strand.

Heading.—The direction of a ship's head.

Heaver.—A short bar of wood tapering at each end used as a purchase.

Helm's a-Lee.—The helm put right over to leeward.

Hogged.—When a vessel has dropped at her extremities she is said to be hogged.

Hogging.—Scrubbing the bottom of a vessel.

Hold On.—An order given when hauling on a purchase "Hold on all you get."

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Holding On.—To continue without altering course.

Holiday.—The space on a clothes line or hammock gantlines between clothes or hammocks badly stopped on; also a space left bare when painting.

Hollow Sea.—A state of sea frequently seen after a gale. Ground swell.

Home.—An operation completely performed. An anchor is said to "come home" when it breaks out of the ground by dragging.

Horse.—A bar of iron across the stern of a boat for the sheet to travel on.

Horse Marine.—A name applied to an ungainly and lubberly person.

Housed.—A mast is said to be housed when partially lowered down.

Hove Down.—When a ship is careened over on her side.

Hove in Sight.—Become visible.

Hove to.—Remaining stationary. In a sailing craft by making one set of sails act against the other.

Hoy.—A small vessel. Such as a "powder hoy" or "provision hoy."

Hug the Land.—To keep as close to the shore as possible.

Hug the Wind.—To keep as close to the wind as possible.

Hull, To.—To strike the hull with shot, &c.

Hull Down.—Said of a vessel when her hull is hidden and only her spars visible above the horizon.

Iron-bound.—A rocky coast without an anchorage is said to be an iron-bound coast.

Irons.—A vessel is said to be in irons when up in the wind, and will not pay off on either tack.

Jack in the Dust.—A name applied to a ship's steward's assistant.

Jacob's Ladder.—A ladder made of rope or wire with wooden bars for steps.

Jetson.—Cargo thrown over board to lighten ship.

Jobation.—A private but severe lecture.

Junk.—Condemned rope. Salt junk, salt beef.

Jury Mast.—A temporary mast erected in lieu of one carried away.

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Keel Haul.—To haul a man under a ship's bottom with ropes made fast to opposite yardarms; an ancient punishment in a man-of-war, more especially in the Dutch Navy.

Kick up a Dust.—To have a disturbance.

Kit.—The clothing of a seaman.

Knuckle Under.—Give way to the opinion of others.

Labour.—A vessel rolling or pitching heavily.

Larboard.—The old term for "Port."

Land Fall.—Finding land when at sea. A ship is said to make a good land-fall when the land is sighted at the point calculated.

Land-locked.—Sheltered on all sides by the land.

Lazy guy.—An extra guy put on a boom or spar to prevent it swinging as the ship rolls.

Lee-board.—Boards fitted to flat-bottomed boats. The lee one is always kept out when on a wind to keep her from drifting to leeward.

Lee-gage.—To leeward of a vessel you are in company with.

Leg Bail.—A man deserting is said to have given leg bail.

Lee Helm.—The amount of helm required to keep a vessel or boat to the wind when sailing close-hauled.

Lee Tide.—A tide that carries a vessel to leeward.

Lee Way.—The drift a vessel or boat makes when sailing near the wind.

Let Fly.—To let go on the instant.

Ligan.—Articles thrown overboard and buoyed for subsequent recovery.

Lip.—A word used by sailors signifying cheek, insolence, &c.

List.—A vessel is said to have a list if she heels permanently to one side.

Lizard.—A piece of rope or wire fitted with a thimble in one end, used for various purposes.

Lubber's Point.—Is a thin vertical black line painted on the inside of the compass bowl is such a position as to indicate the ship's head. It is also termed the Lubber's Line.

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Luff.—To bring a vessel close to the wind.

Lying To.—Keeping the vessel at a convenient angle to the wind and sea in a gale.

Make the Land.—To sight and approach the land after being at sea.

Make Water.—Leaking.

Marry.—To join the ends of two ropes, or to hold two ropes together, that are to be hauled on at the same time.

Master.—The captain of a merchant vessel. The navigator in the old sailing men-of-war.

Making a Stern Board.—Forcing a vessel astern by means of the sails.

Meet Her.—When the helm has been put over in altering course, it is necessary to "meet her" with opposite helm to prevent her swinging too far.

Moon Sail.—A small sail carried by merchant vessels above a sky sail.

Moon Struck.—A phrase used to anyone short of their intellect.

Mouse a Hook.—A seizing of spunyarn put over the bill of the hook to keep it from unhooking.

Muffle.—To muffle the oars is to put some soft substance round the looms when rowing to prevent noise.

Mulct.—A man is said to be mulct of his pay when it is forfeited as a punishment.

Mull.—To mismanage.

Muzzler.—A strong head wind; sometimes called a "nose-ender."

Neap Tides.—The opposite to spring tides; when the tide does not rise or fall much.

Neaped or Beneaped.—The position of a ship when the tide does not rise high enough to float her.

Nock.—The upper end of a sail that sets with a boom.

No Higher.—Not to come nearer the wind when sailing close-hauled.

Nothing Off.—Not to keep more off the wind when sailing close-hauled.

Off and On.—Keeping near the land by heading in and standing off.

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Offing.—To seaward.

Overhaul.—To overtake another vessel; to free the fall of a tackle; to ease up. Also means to examine.

Over-rake.—When a vessel is at anchor in a head sea and the waves frequently break in upon her, they are said to over-rake her.

Overlap.—When anything partly covers another thing. When any part (spars and sails included) of one vessel partly covers any part of another vessel.

Pay Out.—To veer or ease chain or rope.

Pay the Seams.—Is to cover the oakum in caulked seams with hot pitch.

Ply to Windward.—To work to windward.

Port.—The left-hand side of a ship looking forward.

Port Tack.—A vessel is said to be on the Port Tack when she is sailing with the wind on the port side, and port tacks boarded. If the wind is abaft the port beam, and the tacks are not boarded she is said to be "running free with the wind on the port side."

Quarter Cask.—Half a hogshead or 28 Imperial gallons.

Quilting.—Signifies a beating.

Rake.—The inclination of the mast from the perpendicular.

Render.—To ease up; a rope is said to render when it slips without warning, also when it goes freely through any place.

Reach.—Is the distance a vessel can sail without tacking.

Rogue's Yarn.—A coloured yarn found in the heart of all Government rope. Devonport and Chatham have red and yellow yarns respectively.

Rounding up.—Hauling through the parts of a purchase so as to bring the two blocks together.

Run.—The hollow curving in a vessel's bottom that rises and narrows under the quarters. A day's run is the distance travelled by a vessel in 24 hours.

Sag.—A vessel dropping to leeward.

Sagged.—The midship part of a vessel having settled below the level of her bow and stern.

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Scantlings.—The dimensions of all kinds of timber used in the construction of a ship.

Scarf or Scarp.—To join a span or two pieces of timber together wedge fashion.

Scotchman.—A piece of wood, iron, or hide to prevent chafe.

Scud.—Thin clouds going very fast. A ship running before a gale is said to be scudding.

Sea Legs.—The power of walking steadily notwithstanding the ship's rolling and pitching.

Scend.—A ship is said to scend heavily when her bow or stern pitches with great force into the trough of the sea.

Shake the Cask.—To knock the hoops off and lash or hoop up the staves together in a bundle. All empty casks are called shakes.

Sheer.—The rise of a ship's deck at the head and stern, above the midship portion.

Sheer to.—To move over in any direction, as "Sheer to Port" or "Sheer to Starboard."

Sheer Plan or Draught.—A drawing showing (1) a longitudinal vertical section, (2) traverse vertical sections, (3) horizontal sections, of a ship or boat.

Shifting Berth.—To move from one part of an anchorage to another.

Shipshape.—In proper seamanlike manner.

Show a Leg.—An exclamation used in turning the watch out at night.

Shorten Sail.—To take in sail.

Shiver.—To luff up so as to cause the sails to shake. The sheave of a block.

Slack in Stays.—Slow in tacking.

Slant of Wind.—A favourable wind.

Slush.—The fat skimmed off the meat in the coppers.

Slue or Slew.—To turn anything round.

Small Stuff.—A term used for nettlestuff or spunyarn, &c.

Snotter.—The lower support of a sprit.

Snub.—Is to check anything suddenly.

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Snug.—Under safe sail. Anything stowed neatly.

Soldier's Wind.—A fair wind both ways. A wind that permits a vessel to lay her course from one place to another without tacking.

Sound.—Not decayed. To heave the lead.

Spell.—An interval of time. To take a spell is to rest. To spell is to relieve another at his work.

Splice the Main Brace.—To issue an extra allowance of grog.

Spring Stays.—Additional stays intended to replace the stays if shot away.

Spring Tides.—The highest and lowest course of tides, occurring every new and full moon.

Spoon Drift.—Water swept from the tops of the waves by the violence of the wind in a storm.

Sprung.—Damaged by cracking or splintering. A spar is sprung when the fibres of the wood are injured by straining.

Stand on,—Keep in the same direction.

Stand by.—A caution to make ready.

Starboard.—The right-hand side of a ship looking forward.

Start.—To start a rope is to commence easing it. A cask is said to be started when it is opened.

Steerage Way.—When a vessel is moving with sufficient way to be steered.

Steeve.—The upward inclination of a spar.

Starboard Tack.—A vessel is said to be on the starboard tack when she is sailing with the wind on the starboard side and starboard tacks boarded. If the wind is abaft the starboard beam, and the tacks are not boarded, she is said to be "running free with the wind on the starboard side."

Starbowlines.—An old term for the men in the starboard watch.

Stiff.—Not easily inclined. A vessel or boat that stands up well under canvas is said to be stiff.

Stove in.—Broken in.

Surge.—To ease or render quickly. To render a hawser round the capstan when it is being hove in.

Swifting in.—Steadying the shrouds together before rattling down, also to temporarily tauten up the rigging.

Take up.—To tighten up. To shrink.

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Taunt.—Applied to a ship with unusually high masts.

Taut.—Stretch as tightly as possible.

Tell that to the Marines.—A sailor's exclamation when anything very unlikely is told him.

Tend.—Short for attend.

Thole-pins.—Wooden pins shipped in the gunwale of a boat instead of a rowlock for oars to rest in.

Three sheets in the wind.—An expression used by sailors for persons unsteady from drink.

Thrum.—To make a rough surface on a mat by inserting short strands of yarn.

Tight.—Impervious to water. Not leaky.

To Choke a Luff.—To jamb the hauling part under the next part to it against the swallow of the block.

Tom Pepper.—A term for a liar.

Top hamper.—Unnecessary weight carried on deck, or aloft.

To Settle.—To lower a short distance.

Trick.—Generally applied to the spell a man has at the wheel, look-out, chains, &c.

Trim.—The condition of a ship with reference to her position on the water.

Tumble Home.—The sides of a ship near the upper deck inclining inwards are said to tumble home.

Two Blocks.—When two blocks of a tackle meet, preventing your getting any more of the purchase.

Ugly.—When the weather has a threatening aspect.

Under Run.—To follow up a rope, hawser, &c., by hauling it in over a boat which moves in the direction that it is laid out.

Under Way.—Moving through the water. When the anchor is lifted from the ground the ship is said to be underway.

Unship.—To remove.

Up and Down.—Vertically. The cable is up and down when it is vertically taut from the bow to the anchor.

Vane.—A fly horn made of feathers or bunting to show the direction of the wind.

Veer.—To pay or ease out cable. Wind is said to " veer " when it shifts with the hands of a watch, and to " back " when it shifts against the hands of a watch. (It is the reverse way in the Southern Hemisphere.)

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Waist.—The middle part of the upper deck.

Wake.—The track left by a vessel in motion.

Warping.—Hauling a vessel into position by means of a hawser.

Waterborne.—Floating.

Waterlogged.—A vessel full of water but still floating.

Weather Gauge.—A vessel being to windward of another.

Weather Lurch.—A roll to windward.

Weather side.—The side on which the wind blows.

Weather Tide.—A tide making against the wind.

Weigh.—To weigh the anchor is to lift it off the ground.

Wind Rode.—The position of a vessel at anchor when she rides by the force of the wind instead of the tide.

Wing and Wing.—The situation of a boat going dead before the wind with the foresail spread out on one side and the mainsail on the other.

Wind's eye.—That point from which the wind blows.

Woolding.—Winding rope round a mast or yard that is sprung.

Wriggle or Rigol.—Bent steel strips worked on the ship's side over the scuttles to prevent water, running down the side, entering the scuttle.

Yaw.—When a ship does not steer a straight and steady course and her head moves from one side to the other, she is said to yaw about. When the ship's head is swung by the send of the sea so as to throw her off her course, she yaws.

Yaw-sighted.—A sailor's expression for a person who squints.

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SYLLABUS OF COURSES.*

COURSES AND ADVANCEMENT IN RATING.

SEAMEN BRANCH.

Recruiting.

The Seaman Branch is recruited by the entry of :—
Boys : between 15¼ and 16¾ years of age.
Youths : between 16¾ and 18 years of age.
In addition a small number of Special Service Ordinary Seamen are recruited annually, their age being between 18 and 25 at the time of joining the Service.

System of Training.

Boys.

On joining the Training Service all boys pass through a preliminary course lasting 12 weeks, during which they are instructed in seamanship, squad drill, and swimming, and spend one half of their time in school.

At the end of this 12 weeks they are examined, and those who pass the best school examinations may volunteer for either :—

(*a*) The Advanced Class.
(*b*) The Wireless Course.
(*c*) The Signal Course.

The majority of the boys, however, remain for a further four to five months in the Harbour Training Establishment as "ordinary boys," and receive instruction in gunnery, mechanical training, and practical seamanship before being drafted to the Training Squadron.

The advanced class boys have practically the same gunnery and mechanical training courses, but as they continue to devote half their time to school, the number of weeks occupied by these courses is double that of the ordinary boys'.

The object of the advanced class system is to improve the education of a proportion of the more intelligent lads, thus fitting them in the future for higher gunnery and torpedo ratings and for promotion to Warrant Rank, should they prove themselves deserving of advancement.

* These courses are intended only as a guide to officers and men and are subject to frequent revision. In order to make certain that there are no alterations in the syllabus reference should be made to the specialist officer in the ship.

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YOUTHS.

As these lads join the Service at a later age, and will become ordinary seamen more quickly, their training is shorter than that of the boys.

After spending from 10 to 12 weeks in the Youths' Training Establishment, Devonport, they join the Second Fleet for four months sea-training.

A small number of youths are selected for an Advanced Class Course, remaining in the Training Establishment for six months, after which their training is considered complete and they are discharged direct to Second Fleet Ships.

ORDINARY SEAMEN (S.S.).

Their full course consists of 12 weeks' training, 6 weeks in the Royal Naval Barracks, followed by 6 weeks in the Second Fleet.

Courses for Boys and Youths in the Harbour Training Establishments.

Ordinary boys :—
- 12 weeks' seamanship and school.
- 2 weeks' mechanical training.
- 10 weeks' gunnery.
- 4 weeks' practical seamanship (and kitting up for sea).

Advanced class boys :—
- 12 weeks' seamanship and school.
- 8 weeks' mechanical training and school.
- 24 weeks' gunnery and school.

Ordinary youths :—
- 8 weeks' seamanship and squad drill.
- 2 weeks' duty cutter and work of ship.

Advanced class youths :—
- 26 weeks' seamanship, gunnery, mechanical training and school.

Signal boys :—
- 12 weeks' seamanship and school.
- 7 months' signals and school.

Boy telegraphists :—
- 12 weeks' seamanship and school.
- 34 weeks' Morse, instruction in signal and wireless books, mechanical training, wireless telegraphy work and school.

Signal boys (new system) :—
- 12 weeks' seamanship and school.
- 34 weeks' wireless telegraphy, visual signalling, code books, and school.

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NOTES.—A small number of youths are allowed to volunteer for the Signal and Wireless Branches being transferred to the "Impregnable" and Shotley Training Establishments where they go through the same courses as the Boys who are qualifying in signalling or wireless telegraphy.

The present system of training Signal boys and boy telegraphists will shortly be abolished.

Signal boys will in future be trained in both wireless telegraphy and visual signalling.

Sea-Training Courses for Boys and Youths.

Ordinary and advanced class boys are drafted to the Training Squadron for a four months' course, which includes seamanship, gunnery, and school, special attention being paid to boat work.

Ordinary youths are drafted to the ships of the Second Fleet for a four-months' sea-training course of seamanship, gunnery and mechanical training.

Advanced class youths are drafted direct to the Second Fleet, their training being complete.

Signal boys are sent to the General Depôts on the completion of their course and are drafted to sea-going ships as soon as possible.

Boy telegraphists are drafted direct to sea-going ships at the end of their course in H.M.S. "Impregnable."

ADVANCEMENT OF BOY TO ORDINARY SEAMAN.

No examination.

Boys are rated at the age of 18, or if particularly promising at the age of 17½.

A very few specially selected boys are rated ordinary seaman on leaving the Training Squadron, irrespective of age.

Youths are rated after four months' service, if 18 years of age and specially recommended for the rating; otherwise after six months' service (if 18), or at the age of 18.

A very few specially selected youths are rated ordinary seaman on completing their training in the Second Fleet.

ORDINARY SEAMAN TO ABLE SEAMAN.

To pass the following examination :—

Subjects.—Seamanship, Torpedo, Gunnery, Field Training, Stokehold Work, Use of Mechanical Tools.

In order to qualify, 70 per cent. of marks in each subject must be obtained.

The details of each subject are as follows :—

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Seamanship.

To be fairly efficient in steering, heaving the lead, rowing, knotting, and splicing hemp and wire rope, and in the general duties of a seaman. To make and take in semaphore at a slow rate, and to know the colouring and applications of such flags and pendants as will enable him to make and look out a signal in the Boat's Signal Book.

Torpedo.

(1) To be acquainted with test batteries and simple testing.

(2) To replace an incandescent lamp. Care in handling electrical appliances on board ship.

(3) To take any number above 2 at a submerged or above-water torpedo tube.

(4) To take No. 2 at a searchlight, and to pass the word intelligently between the projector and other places.

(5) To have a general idea of the stowage of electrical and mining stores and the names of the different articles.

(6) To be able to use the loud-speaking telephones or voice pipe bells.

(7) The principles of electric firing apparatus of guns, and night sights.

(8) The principle of working motor switches so as not to damage the motor, and how to oil, start, and stop motors.

(9) Dropping gear and outrigger drill.

Gunnery.

To know the drill at all guns in the ship and stripping and assembling of all these guns and their mountings.

All the ammunition supplied to the ship.

To pass in dotter, deflection teacher, swinging target and loading teacher, and to fire 20 rounds aiming rifle, and six rounds 3-pr.

NOTE.—Ordinary seamen are not examined in turret gun drill.

Field Training (at sea).

Rifle, squad, and company drill, including use of pistol, to have a knowledge of drill stripping and assembling of a machine gun. Also field and machine gun drill.

Ordinary seamen when qualifying for A.B. in barracks in this subject have a slightly longer course.

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Stokehold Work.

(1) Sweeping tubes and backs, cleaning, &c.
(2) Bunker work and firing.
(3) Firing, cleaning fires and general stokehold watch-keeping.

Use of Mechanical Tools.

To have a knowledge of :—

Watertight doors, sluices, fire mains, ventilation system.

To know how to use the following tools :—

Levers.
Jacks.
Purchases, Weston's and others.
Spanish windlass.
Hammers, hand and sledge.
Drifts and punches.
Brace and bits.
Ratchet brace.
Screwdriver.
Spanners.
Tommies.
Wedges.
Files.
Hatchet.
Chisel.

FOR LEADING SEAMAN.

Must have two years' service as A.B., one of which must have been afloat, and must be recommended for advancement by the Captain of last seagoing ship.

Must pass the following examination :—

(*a*) Helm, compass and lead,
(*b*) Practical rigging,
(*c*) Sailmaking,
(*d*) Charge of boats under oars and sail,
(*e*) Anchor work,
(*f*) Semaphore,
(*g*) thorough knowledge of the rule of the road at sea, and the use of sound signals in connection with alteration of course.
(*h*) Knowledge of signals and flags in connection with Boat's Signal Book,
(*i*) The general duties of a leading seaman in a modern man-of-war.

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For Petty Officer.

Must have one year's service as leading seaman in a seagoing ship and acting qualification of S.G. or S.T.

Must pass the following examination :—

(1) An educational test, consisting of :—(*a*) Writing an ordinary passage of English to dictation ; (*b*) a simple paper on the first four rules in arithmetic, simple and compound, with vulgar and decimal fractions (no questions to involve a knowledge of special tables of weights and measures), calculating the average points obtained at practices, making out mess bills, &c., &c.

(2) An examination in the seamanship of the present day, including (*f*) elementary signals ; (*g*) semaphore ; (*h*) thorough knowledge of the rule of the road at sea, and the use of sound signals in connection with alterations of course ; (*i*) management of boats under steam, sail, and oars ; (*j*) helm, compass, and lead ; (*k*) splicing in hemp and wire ; (*l*) anchor work ; (*m*) rigging sheers and derricks ; (*n*) the general duties of a petty officer in a modern man-of-war.

(3) The watertight fittings, pumps, and simple constructive details of the ship in which the candidate is serving.

(4) Writing up the log book ; understanding ordinary printed instructions on technical matters. The examination in these subjects will be conducted orally.

For Chief Petty Officer.

Must be a petty officer, and have not less than five years' combined service as petty officer and leading seaman (over three years and passed for petty officer).

Selected by fitness for the rating.

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GUNNERY AND TORPEDO COURSES FOR SEAMEN AT GUNNERY AND TORPEDO SCHOOLS; ALSO QUALIFICATIONS FOR PHYSICAL TRAINING INSTRUCTORS.

GUNNERY.

Seamen Gunners (S.G.).—This rating is open to leading seamen and A.B.'s qualified as Acting S.G., or who have been recommended for S.G.

The men will be formed into classes of not more than 10, and will carry out the following courses :—

FIELD TRAINING COURSE.

Subject.	Length of Course.	Marks.	Remarks.
	Days.		
Field exercise and pistol –	7½	150	
Field and machine gun –	7½	50	
Musketry – – –	4½	—	
Examination – – –	2	—	
Total – – –	12½	200	

DRILL COURSE.

	Days.		
Gun drill – – –	7½	100	
Stripping – – –	9	150	
Turret – – – –	5½	75	
Ammunition – – –	4	75	
Examination – – –	1½	—	
Total – –	27½	400	

To qualify, the following marks must be obtained :—

Field training course – – 160 out of 200
Drill course – – – – 320 ,, ,, 400

All examinations will be carried out at the end of the drill course, except in turret, which will be carried out at the end of that instruction.

Men who successfully pass the examination in the field training and drill course will proceed to carry out the shooting course.

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Shooting Course for Seaman Gunner.

Instructional apparatus – – 14 days.

Firings :—

Aiming rifle, ·303-in. 4-in. Q.F., by day – – – –	20	rounds	In sloop.
Aiming rifle, ·303-in. 3-pr. S.A., by day – – – –	20	,,	
Aiming rifle, ·303-in. 3-pr. S.A., by night – – – –	20	,,	
Service, 3-pr. S.A., by day –	10	,,	
,, 4-in. Q.F., by day –	5	,,	
,, 12-pr. Q.F., by day –	10	rounds	In cruiser.
,, 12-pr. Q.F., by day –	10	,,	

In addition, the following allowance of ammunition is to be fired from a T.B.D. by night if circumstances permit :—

Aiming rifle, ·303-in. 12-pr. Q.F. – –	20	rounds
,, ,, ·45-in. 6-pr. Q.F. – –	20	,,

The T.B.D. firing may be carried out when convenient, but after the commencement of the course with instructional apparatus.

Qualifications.—The candidate must pass the instructional apparatus to the satisfaction of a Staff Lieutenant.

The second 10-round series with 12-pr. ammunition will be the examination in shooting, and a qualification of " fair " is required.

Qualifying Courses for Gunlayers.

Gunlayer 3rd Class.

This rating is open to men recommended from seagoing ships, and for those selected for good shooting whilst qualifying for Seaman Gunner.

Instructional apparatus :—

Men from sea – – – – –	10	days
Men from gunnery school – – –	7	,,

Firings :—

Aiming rifle, ·303-in. 4-in. Q.F., by day – – – –	25	rounds	In sloop.
Aiming rifle, ·303-in. 3-pr. S.A., by day – – – –	25	,,	
Aiming rifle, ·303-in. 4-in. Q.F., by night – – – –	20	,,	
Service, 4-in. Q.F., by day –	8	,,	
,, 12-pr. Q.F., by day –	10	,,	In cruiser.
,, 12-pr. Q.F., by day –	10	,,	
,, 12-pr. Q.F., by night –	7	,,	

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Candidates will fire an instructional series from a T.B.D. by night or by day as circumstances require.

Aiming rifle, 12-pr. or 6-pr.	50 rounds	In T.B.D.
Service, 12-pr.	5 ,,	

Qualifications.—The candidates are to pass at the instructional apparatus to the satisfaction of a Staff Lieutenant, a qualification of V.G. being required.

The second 10-round series with 12-pr. ammunition will be the examination in shooting, and the final qualification in shooting will be assessed on this.

At the conclusion of the course the best man will be rated gunlayer 3rd class, a qualification of V.G. being required, those not selected remaining S.G.'s.

Gunlayers 3rd class, who, when qualifying as such, appear likely to make good shots with a heavy gun, may be selected to qualify as gunlayer 2nd class.

Gunlayer 2nd Class.

This rating is open to men recommended from seagoing ships and for those selected for very good shooting whilst qualifying for gunlayer 3rd class.

Instructional apparatus :—

Men from sea	10 days
Men from gunnery schools	7 ,,

Firings :—

Aiming rifle, ·303-in., 20 rounds from gunboat.

Aiming rifle, ·303-in. 4-in. Q.F., by day	20 rounds	In sloop.
Aiming rifle, ·303-in. 4-in. Q.F., by night	20 ,,	
Service, 4-in. Q.F., by day	10 ,,	
,, 6-in. B.L. or Q.F., by day	5 ,,	In cruiser.
Aiming rifle, 1-in. 6-in. B.L. or Q.F., by night	20 ,,	
3-pr. sub-calibre, in 6-in. B.L. or Q.F., by night	10 ,,	
Service, 6-in. B.L. or Q.F., by night	5 ,,	

Qualifications.—The candidates are to pass at the instructional apparatus to the satisfaction of a Staff Lieutenant, a qualification of V.G. being required.

The 10-round series with 6-in. service ammunition will be the examination in shooting, and the final qualification in shooting will be assessed on this.

At the conclusion of the course the best man will be rated gunlayer 2nd class, a qualification of V.G. being required, those not selected remaining gunlayer 3rd class.

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In the case of acting gunlayers 2nd class who have been trained from S.G.'s in ships not allowed gunlayers 3rd class, and who fail for gunlayers 2nd class on return to the gunnery school, may be given the rating of gunlayer 3rd class at the discretion of the Captain of the Gunnery School.

In the case of acting gunlayers 1st class who have been trained from gunlayers 3rd class in ships not allowed gunlayers 2nd class, and who fail for gunlayer 1st class on return to the gunnery school, may, at the discretion of the Captain of the gunnery school, be put through the Shooting Course for gunlayer 2nd class and be given that rating if successful.

Gunlayers 1st Class.

The rating of gunlayer 1st class is to be held only by petty officers, leading seamen and marines of substantive non-commissioned rank.

Except in the case of gunners' mates and acting gunlayers 1st class, trained afloat, seamen and marines are not eligible for the rating who have not been to sea as gunlayers 2nd class or gunlayer 3rd class.

Course.

Instructional appliances – 8 days.

Firings :—

Two days from gunboat. ·303 inches from hydraulic worked mounting, 40 rounds.

Sub-calibre, 6-pr. – – 30 rounds } from battle-
Service, turret gun – – 10 „ } ship tender.

The successful candidates in shooting will continue the course as follows :—

Hydraulics – – – – 13½ days, unless already a gunner's mate.
Turret drill and stripping – 6½ days (for R.M.A. and R.M.L.I. only).

Qualifications.—The candidates are to pass at instructional apparatus to the satisfaction of a Staff Lieutenant, a qualification of V.G. being required.

The firing with service ammunition will be the examination in shooting, and the final qualification will be assessed on this.

For gunlayer 1st class a qualification of V.G. is required.

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PETTY OFFICER (G.).

The rating is open to Petty Officers who have held the rating (acting or confirmed) of S.G. or above.

They will be formed into classes of not more than 10 and carry out the following course :—

Subject.	Length of Course.	Marks.	Remarks.
Field exercise – –	9	150	
Field gun – – –		25	
Musketry – – –	4½	—	
Gun drill – – –	7	150	
Stripping – – –	5	150	
Turret – – – –	5	100	
Ammunition – – –	3	50	
Shooting course with instructional apparatus.	3	—	
Hydraulic lectures – –	4	25	
Fire control – – –	4	100	
Gunboat firing – –	—	—	
Examination – – –	2	—	
Total – –	46½	750	46½ days includes all examinations.

The examination will be carried out at the end of the whole course, except in turret drills, when it will be carried out at the end of that instruction.

Petty Officers (G.) who are not gunlayers will also carry out the shooting course laid down for seaman gunners requalifying. During this course they will in turn take charge of their class at instructional apparatus.

To qualify or requalify as Petty Officer (G.), 80 per cent. of marks must be obtained, and a qualification of "Good" or "Ability to Command" is required.

GUNNER'S MATES.

Men passing for the rating of Gunner's Mate, who are not gunlayers 2nd class, will be put through the course for gunlayer 2nd class, and must obtain a qualification of "Good," but will not receive pay or rating of gunlayer 2nd class.

Those gunners' mates who prove themselves the best shots in the course may be given the opportunity to qualify for gunlayer 1st class.

Men selected to qualify as gunners' mates must be at least leading seamen and passed for Petty Officers and S.G.'s.

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Before commencing the course, all men recommended for it are to be put through a short examination by a Senior Gunnery Lieutenant, with a view to eliminating men who are not likely to be ultimately successful, and to ascertain whether their intelligence and application are of a sufficiently high order to justify their acceptance.

The course commences with a school course of 40 days, which is to take place before any other instruction.

Before doing the school course candidates will be required to pass a preliminary examination in reading, writing, dictation, and elementary arithmetic.

Outline of the Course.

Subject.	Length of Course.	Marks.	Remarks.
	Days.		
School – – – –	40	200	40 days includes examinations.

Gunnery Course.

Gun drill – – –	9	125	
Stripping – – –	15	175	
Field exercise, musketry and pistol.	20	150	
Field gun – – –		75	
Turret – – – –	5	100	
Ammunition – – –	6	100	
Mechanical Drawing –	5	50	To be taken before hydraulics.
Gunnery lectures – –	13	175	
Hydraulics – – –	15	100	
Examination – – –	2	—	
Total – –	90	1,050	90 days includes all examinations.

Preliminary Gunnery Examination.—Immediately after completing 19 days' instruction in Gunnery, a preliminary examination of all candidates is to be held.

This examination is to be so framed as to ascertain whether a man has a reasonable chance of obtaining the required standard at the end of the course. If it is clear that he has not, he is to discontinue the course.

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TORPEDO.

Seaman Torpedo Man (S.T.).—This rating is open to able seamen and leading seamen only. Qualifying course is as follows :—

48 days.	Days.
Seamen's electrical – – –	20
,, practical – – –	8
,, Whitehead – – –	17
Total – – –	45

Captains of seagoing ships may rate selected men Acting S.T.s.

Leading Torpedo Man (L.T.O.).—Rating open to able seamen and all higher ratings. Must have qualified as S.T. Preference will be given to men who have served at sea as S.T.s. Qualifying course is as follows :—

74 days.	Days.
School – – – –	20
Seamen's practical – – –	5
,, Whitehead – – –	15
Senior lecture room – – –	10
Electric light – – – –	10
Special Whitehead – – –	13
Instruction in grummet making –	1
Total – – –	74

Captains of seagoing ships may rate selected men *Acting* L.T.O.s in actual vacancies in complement.

Torpedo Gunner's Mate, Lower Standard (T.G.M., L.S.).—This rating is open to leading seamen passed for Petty Officer and all higher ratings. Preference will be given to men who have served at sea in ratings above A.B. The qualifying course is as follows :—

148 days.	Days.
School – – – –	40
Senior lecture room – – –	20
Electric light – – – –	25
Special Whitehead – – –	35
Signals – – – –	3
As instructor in—	
Seamen's electrical – –	10
,, practical – –	5
,, Whitehead – –	15
Total – – –	148

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Coxswain of Torpedo Boat (T.C.).—This rating is open to Chief Petty Officers (T.) and Petty Officers (T.), and also to Chief Petty Officers (G.) and Petty Officers (G.) holding non-substantive rating not higher than S.G. Also, they are subject to a medical test of "eyesight" prior to commencing their course. Qualifying course is as follows :—

	Days.
Signalling – – – –	5
Management of Torpedo Boats –	10
Management of Torpedo Boat Destroyers – – – –	25
School (internal economy of torpedo craft, messing organisation, keeping books and accounts) – –	14
Examination – – – –	1
Total – – –	55

Captains of seagoing ships may fill actual vacancies in the complement by rating selected Chief Petty Officers and Petty Officers, *Acting* Coxswain of Torpedo Boat (Act. T.C.).

Coxswains of Torpedo Boat and Acting Coxswains of Torpedo Boat will not be allowed to hold any other non-substantive rating.

Chief Petty Officers and Petty Officers who hold gunnery or torpedo ratings inferior to gunlayer 3rd class, and leading torpedo man are called Chief Petty Officers (G.) or Petty Officers (G.) and Chief Petty Officers (T.) or Petty Officers (T.) respectively.

Physical Training Instructors.

Physical Training Instructors, 2nd Class (P.T.I. 2nd Cl.).—Must be a Petty Officer or leading seaman, of very good character, and, as a general rule, under 25 years of age. No one below 5 feet 5 inches in height and with a chest measurement less than 35½ inches is to be selected unless he is specially chosen for manner and power of command.

Volunteers are to be medically examined, and the Medical Officer of the ship is to certify that the men volunteering are well developed, suitable from the point of view of physique and in every way in a fit state of health to undergo the Physical Training Course.

Will be selected to qualify by the Superintendent of Physical Training after being recommended from a seagoing ship.

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Physical Training Instructors 1st Class (P.T.I. 1st Cl.).—Will be selected from Instructors 2nd Class who are recommended for advancement by their Captain. Will be rated 1st class upon requalifying, either at the expiration of three years from the date of qualifying as 2nd Class Instructors, or upon any subsequent requalifying.

Qualifiers who obtain 90 per cent. of the marks allowed at their final examination for Physical Training Instructor may, however, be rated 1st Class Instructors on qualifying, provided not more than 10 per cent. of the number of P.T.I. allowed are so rated.

Staff Physical Training Instructor.—Must be a C.P.O., P.O. (N.S.) or P.O. 1 cl. Will be selected from Physical Training Instructors 1st Class, and will hold the appointment of Staff Instructor for not more than three years.

A Senior Staff Instructor will be selected from among the Staff or 1st Class Instructors, and will hold the appointment at the discretion of the Superintendent of Physical Training for three years which may be extended to five by the Commander-in-Chief upon the recommendation of the Superintendent.

SIGNAL RATINGS.

Signal boys will be rated ordinary signalmen at 18, or, if particularly promising, at 17½.

COURSE FOR SIGNALMEN AND ORDINARY SIGNALMEN.

Duration of course 30 working days.
Examination – 3 „ „

Total – 33 days.

Syllabus.

1. Semaphore – – – – – once daily.
   Flag-waving – – – – – „ „
   Flashing – – – – – – „ „
   Sounder – – – – – – „ „
   Buzzer – – – – – – „ „

   The sending in these instructions is to be done entirely by the class, each rating taking it in turn, except on Fridays, when the instructor is to send, from which exercise the weekly percentage will be arrived at.
2. Read a night exercise from a truck lamp, according to percentage obtained the previous week.
3. Flag signalling. Three-quarters of an hour. Four days a week.

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4. Marching manœuvres. Quarter of an hour daily.
5. Physical training. Two hours a week.
6. School. One hour a week.
7. Instruction in the method of working the searchlight, cruiser arc, and other lamps.
8. Instruction in Wireless Telegraphy, one hour a week. Lectures being arranged as follows :—

First Week :—

Description of contents of Vol. 2, Fleet Signal Book, and Part 2 Signal Manual.
Distinguishing features and classification of signals, use of Code, Cypher, and " En Clair."
System of Call Signs.

Second Week :—

Methods of calling up, answering, &c., with examples of simple procedure.
General construction of a message.
Single letter procedure signals with examples.

Third Week :—

Silence and Negative Silence signs. Executive repetitions and corrections. Coding numerals, Transposed Alphabet. Timing of messages. Coding of Time.

Fourth Week :—

Position and Emergency Tables.
Control of W.T. Signalling.
Naval shore stations. Classes and uses.
Naval shore stations for relaying messages to and from H.M. Ships.

Fifth Week :—

Admiralty messages to and from H.M. Ships.
Use of shore stations.
Private telegrams through Naval shore stations.
Fleet organisation. Group system.
W/T Guards and other duties.

Sixth Week :—

Fleet Manœuvring by W.T.
(*a*) All ships on one wave.
(*b*) Ships on Group system.
Rules to be observed by W.T. Operator.
Range of various service W.T. Installations.

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Weekly Syllabus.

Note.—Models and brass ships are to be used for all Instructions, including Manœuvring and Cruiser questions and instructions for signalling with lights and by sound.

First Week:—

Single Flags; pendants and substitutes. Speed and Helm signals. Definitions. Instructions relating to signalling by flags. Instructions relating to and manner of using distinguishing signals.

Second Week:—

Instructions for the conduct of a fleet "by day." Instructions for the conduct of a fleet "by night." Instructions relating to signalling by lights (taught with Model). Different types of flashing lamps, including searchlight and cruiser arc lamp, and manner of using same. Instructions for the conduct of a fleet in a fog. Instructions for signalling by sound (taught with model).

Third Week:—

Organisation of a fleet (including cruisers). Forming and disposing signals. Equal speed signals. Stationing signals. Miscellaneous manœuvres. (Brass ships and mooring boards to be used.)

Fourth Week:—

Instructions for alteration of course up to eight points by compass pendant, with explanation of the tables. Cruiser instructions and signals except table of angular distances. All single flag tables. Flotilla signal book. Black flag codes and signals for addressing submarines.

Fifth Week:—

Practical instruction in heliograph. Instructions for dress signals. Boats and vocabulary signal books. Hints to signalmen as contained in Signalmen's Handbook. Explanation of how to use a Very's pistol. How to fire a rocket and how to work cable flags.

Sixth Week:—

International Code and British Signal Manual. Principal foreign ensigns and admirals' flags. Distinguishing lace worn by British naval and military officers. Lights carried by vessels at night. Instructions for preventing collisions at sea. Difference in navigational lights. (Revolving, flashing, &c., to be explained.)

Résumé of subjects taught.

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Examination.

Subject.	Rate.	Marks allowed.	Marks required to pass	
			For Signalman.	For Ordinary Signalman.
Semaphore – –	20	100	94	92
Flag Waving – –	12	100	92	88
Sounder – –	Number of words to be read correctly in five minutes.		70	60
Buzzer – – –				
Paper, Part 1 –	—	200	170	160
Part 2 –	—	200	170	160
Part 3 –	—	200	170	160
W.T. Paper (5 questions).	—	50	42	40

Note.—In addition to above subjects. Signalmen and Ordinary Signalmen will be examined in the following. No marks being allotted but the proficiency shown being taken into account when assessing results.

(A) Making a message with mechanical semaphore, hand flags and Morse flag.
(B) Searchlight.
(C) Heliograph.
(D) *Vivâ voce* examination at model on the instructions for flashing and sound signals.
(E) Colours and meanings of flags, speed and helm signals.
(The marks for this subject are included in total marks for paper, questions being left blank for this purpose.)

Course for Leading Signalmen.

Duration of course – –	30	working	days.
Examination – – –	3	,,	,,
Total – – –	33	,,	,,

Syllabus.

1. Semaphore. Once daily.
Flag Waving ,, ,,
Flashing ,, ,,
Sounder ,, ,, during Signal Book instruction.
Buzzer ,, ,, ,, ,, ,, ,,

The sending in these instructions is to be done entirely by the class, each rating taking it in turn, except on Fridays when the instructor is to send, from which exercise the weekly percentage will be arrived at.

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2. Read a night exercise made on a truck lamp according to percentage obtained previous week.
3. Flag signalling. Three-quarters of an hour four days a week.
4. Marching manœuvres. Quarter of an hour daily.
5. Instruction in the searchlight, cruiser arc, and other lamps.

Note.—Models and brass ships are to be used for all Instructions, including manœuvring and cruiser questions and Instructions for signalling with lights and by sound.

Weekly Syllabus.

First Week :—

1st Day.—Contents of signal books, single flags, pendants, and substitutes.

2nd Day.—Distinguishing signals, manner of using distinguishing signals.

3rd Day.—Compass table and instructions for "alter course" by compass pendant with alter course tables. Forming and disposing; equal speed and stationing signals (brass ships to be used).

4th Day.—Distribution of gun-fire signals and action signals, miscellaneous manœuvring signals.

5th Day.—General signals. Résumé.

Second Week :—

1st Day.—Definitions.

2nd Day.—Instructions for organisation of a fleet. Instructions for conduct of a fleet.

3rd Day.—Instructions for conduct of a fleet.

4th Day.—Instructions for conduct of a fleet at night. Instructions for conduct of a fleet in a fog.

5th Day.—Instructions for equal speed, forming and disposing and stationing signals. Résumé.

Third Week :—

1st Day.—Instructions for signalling by flags and flotilla signal book.

2nd Day.—Instructions for signalling by lights, signs to be used with Morse code, and manner of using same (model to be used).

3rd Day.—Instructions for signalling by sound (model to be used).

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4th Day.—Instructions for conduct of cruisers.

5th Day.—Instructions for conduct of cruisers. Plate of dress ship and dates of dressing ship. Résumé.

Fourth Week:—

1st Day.—Single flag table for fleet manœuvring. Towing table. Dress signals. Black flag code and signals for addressing submarines.

2nd Day.—Instructions for speed signals. Instructions for helm signals. Signals for mine-sweepers. Instructions for placing temporary navigation marks. Flag of truce.

3rd Day.—International Code. British Signal Manual.

4th Day.—Instructions for flag-waving, semaphore, and heliograph.

5th Day.—Hints to signalmen as contained in Signalmen's Handbook. Organisation of signal department stores supplied to signal department. Books supplied to signal department and care of same log forms, &c., supplied. Résumé.

Fifth Week:—

1st Day.—Principal foreign ensigns and admirals' flags. Plate of house flags and funnels.

2nd Day.—Relative ranks, Army and Navy, and shoulder badges. Lace on sleeves, Army and Navy. Badges in flags flown by certain officials. Table of gun salutes. Instructions *re* same and flags flown when saluting. Instructions for flying ensign, Union Jack, and pendant. Extracts from King's Regulations which concern signal department and are not contained in Signalmen's Handbook.

3rd Day.—Navy and army signalling. Flashing lamps and their uses.

4th Day.—Instructions for preventing collisions at sea. Lights carried by vessels at night. Different navigation lights as seen at sea. Special navigation lights and signals.

5th Day.—Boats' signal book. Vocabulary signal book. Principal buoys and beacons. Résumé.

Sixth Week:—

Résumé.

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Examination.

Subject.	Rate.	Marks allowed.	Marks required to pass.
Semaphore – – – –	20	100	96*
Flag Waving – – –	12	100	96
Flashing – – – –	10	100	94·7
Paper on Signal Books :—			
Part 1 – – – –	—	200	170
Part 2 – – – –	—	200	170
Part 3 – – – –	—	200	170

* The average result of a message made by mechanical semaphore and hand flags is to be taken as result.

NOTE.—Leading Signalmen passing for Yeoman at the end of their book course will be required to obtain the same percentage and be examined in the same subjects as Yeomen requalifying. Leading Signalmen requalifying will be examined in the following subjects, no marks being allotted, but the results will be taken into consideration :—

(*a*) Making a message with mechanical semaphore, hand flags, and Morse.
(*b*) Searchlight.
(*c*) Heliograph.
(*d*) *Vivâ voce* examination at flashing model to illustrate the instructions for flashing and sound signals.
(*e*) Reporting signals and working ships on mooring board at flag exercise.

Signalmen passing for Leading Signalmen will be examined in the same subjects as Leading Signalmen requalifying in book course with the exception of (*e*) as above. They will be required to get the same results in buzzer and sounder as Leading Signalmen requalifying, but will not have any other examinations in Telegraphy or W/T, except the W/T paper of five questions which is given to Signalmen requalifying.

SIGNAL BOOK COURSE FOR CHIEF YEOMEN AND YEOMEN.

Duration of Course.

Signal books – – –	25	working	days.
Examination – – –	3	„	„
Total – –	28	„	„

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Syllabus.

1. Semaphore, Flag waving, Flashing — To be carried out at discretion of Instructor.

The sending in these instructions is to be done entirely by the class, each rating taking it in turn except on Fridays when the instructor is to send, from which exercise the weekly percentage will be arrived at.

2. Read a night exercise made on a truck lamp according to percentage obtained previous week.
3. Flag signalling.—Three-quarters of an hour four times a week.
4. Marching manœuvres.—Quarter of an hour daily.
5. Instruction in searchlight, cruiser arc and other lamps.

Note.—Models and brass ships are to be used for all instructions, including manœuvring and cruiser questions and instructions for signalling with lights and by sound.

Weekly Syllabus.

First Week:—

1st Day.—Single flags and pendants; substitutes, distinguishing signals.

2nd Day.—Definitions; manner of using distinguishing signals.

3rd Day.—Action signals; distribution of gun-fire signals, oblique and equal speed pendant manœuvres.

4th Day.—Compass table; alteration of course by compass pendant. Tables used.

5th Day.—Equal speed signals and manœuvres; miscellaneous signals and manœuvres; forming and disposing signals, stationing signals. Single flag manœuvring tables.

Second Week:—

1st Day.—General signals, dress signals, towing signals, black flag codes, signals for submarines.

2nd Day.—Instructions for signalling by flags.

3rd Day.—Speed and helm signals; organisation of fleet, including cruisers.

4th Day.—Instructions for forming and disposing signals. Equal speed and stationing signals.

5th Day.—Instructions for conduct of a fleet.

Third Week:—

1st Day.—Instructions for the conduct of a fleet at night. Signs to be used with Morse Code and manner of using the same. Flashing lamps and their uses.

2nd Day.—Instructions for signalling by lights. (To be taught in conjunction with flashing model.)

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3rd Day.—Instructions for conduct of a fleet. Fog. Instructions for signalling by sound. (To be taught in conjunction with flashing model.)
4th Day.—Instructions for conduct of cruisers.
5th Day.—Instructions for conduct of cruisers.

Fourth Week:—
1st Day.—Signals for mine-sweeping vessels, buoys and beacons, flag of truce; dress ship plate.
2nd Day.—International Code, British Signal Manual.
3rd Day.—Instructions relating to semaphore, flag waving and heliograph.
4th Day.—Army and Navy signalling.
5th Day.—Boats' Signal Book, Vocabulary and Flotilla Signal Books. Home Fleet Signal Orders.

Fifth Week:—
1st Day.—Foreign ensigns, admirals' flags, flags and funnels.
2nd Day.—Gun salutes. Flags flown by certain officials. Relative ranks; shoulder badges; distinguishing lace on sleeves of naval and military officers.
3rd Day.—Instructions for preventing collisions at sea. Lights carried by vessels at night. Different types of lights used for navigational purposes.
4th Day.—Signalmen's Handbook. King's Regulations and Admiralty Instructions not contained in Signalmen's Handbook.
5th Day.—Résumé.

EXAMINATION.

Subject.	Rate.	Marks Allowed.	Passing Marks.	
			For C.Y.S.	For Yeomen.
Semaphore – – –	20	100	98·	98·
Flag waving – – –	12	100	96·	96·
Flashing – – –	10	100	97·3	97·3
Paper on Signal Books—				
Part 1 – – –	—	200	180	170
Part 2 – – –	—	200	180	170
Part 3 – – –	—	200	180	170
Extra Paper – –	—	100	90	85

* The average obtained from messages made by mechanical semaphore and hand flags is to be taken as the result.
† Chief Yeomen and Yeomen will be given the same paper in Signal Book Subjects.

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Men passing for Chief Yeomen or Yeomen or requalifying in those ratings will also be examined in the following subjects, no marks being allotted, but the results will be taken into consideration :—

(A.) Taking charge of a mast at flag exercise and reporting signals.
(B.) Working ships of a fleet and cruisers on mooring board at flag exercise.
(C.) Taking charge of a class at marching manœuvres.
(D.) Searchlight.
(E.) Heliograph.
(F.) Making a message with mechanical semaphore; hand flags; and Morse flag.
(G.) *Vivâ voce* examination at flashing model to illustrate the instructions for flashing and sound signals.

TELEGRAPHY COURSE FOR CHIEF YEOMEN, YEOMEN LEADING SIGNALMEN, AND FOR LEADING TELEGRAPHIST QUALIFYING FOR PETTY OFFICER TELEGRAPHIST.

Duration of Course – – 10 working days.
Examination – – – One day.

Syllabus.

1. Sounder and buzzer daily.
2. How to handle a key. How to send Morse on an inker.
3. Instruction in procedure in use between Post Office and H.M. Service signs used in telegraphy. Code time. Prefixes. Abbreviations in use between Post Office and H.M. Service. Counting of words in a message, especially compound words.
4. Adjustments and connections.

Note.—During one hour per week, lectures to be given by Torpedo Gunner's Mate, on the adjustment of instruments, joining up for direct working and relay working and the construction of a relay.

Examination.

1. Reading a message on sounder and buzzer, including Preamble, according to rates laid down for respective ratings.

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2. A thorough knowledge of procedure including prefixes, counting of words, abbreviations, &c., on which a paper of 12 questions will be given. 100 marks, 90 per cent. required to pass.
3. *Vivâ voce* examination in adjustments, joining up for direct and relay working and how to find a break.
4. Sending a message on tape machine, sounder and buzzer.

Note.—No marks will be allotted for (3) and (4), but the results will be taken into consideration.

WIRELESS TELEGRAPHY COURSE FOR CHIEF YEOMAN, YEOMAN, AND LEADING SIGNALMEN.

Duration of course – – 15 working days.
Examination – – – 1 day.

Syllabus.

1. Instruction in short wireless procedure (manœuvring). Procedure of practical working. Daily.
2. Main installation procedure. Using shore wireless stations.
3. General duties of wireless telegraphy officer. Detailing of wireless telegraphy guards.
4. Coding and decoding.
5. Wireless telegraphy exercise daily.
6. Lectures on wireless telegraphy (laid down in weekly syllabus) and contents of signal books.

Weekly Syllabus.

First Week:—

Procedure. Description of Fleet Signal Book, Vol. 2, Flotilla Signal Book, Vol. 2, and Signal Manual. Distinguishing features and classification of signals. Use of code, cypher, and plain language. Single letter signals. Two letter groups. Naval call signs. Collective and special call signs. Three, four, five, and seven letter groups. Instructions for the use of single letter procedure signals and signs with illustrative examples. Silence and negative silence signs. Repetitions and corrections. Use of the executive sign. Transmission of numerals by W.T. Instructions for the use of transposed alphabet. Manner of coding the

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names of merchant vessels. Steamship companies and foreign men-of-war. Timing of messages. Coding of time. Instructions for the use of operating signals. The procedure of calling up. Transmitting and receiving. The component parts of a W.T. message.

Second Week :—

Examples of special procedure (with respect to the single procedure signals B, K, M and T). Instructions for use of ship's position table. Instructions for the use of code in torpedo craft and other of H.M. vessels not supplied with Fleet Signal Book, Vol. 2. Instructions relative to the position table for torpedo craft. Reports of sighting the enemy by torpedo craft. W.T. procedure used by Whitehall and naval high power shore stations. Instructions for a fleet in thick weather or at night when ships are darkened. General principles of W.T. organisation. Control of W.T. signalling. Routes of messages between Admiralty and ships. Intercommunication between shore stations. Intercommunication between ships. W.T. organisation for torpedo craft. W.T. organisation for squadrons and detached ships which are not within range of a naval high-power station situated in the British Isles or Mediterranean. The reporting of the position, course and speed to the Admiralty.

Third Week :—

Transmission of private telegrams by W.T. table of wavelengths. Fleet organisation. Group system. Fleet manœuvring by W.T. —(1) All ships on the same wave. (2) All ships on group system. Use of the Playfair Code. Duties of W.T. officer. Manner of wording replies to messages. To ascertain the name of a vessel by W.T. To challenge a ship by W.T. Organisation of coding staff, logs, records and reporting messages.

Examination.

Subject.	Marks Allowed.	Marks required to Pass.
Paper (20 questions) – –	200	180
W.T. procedure (*viva voce*) –	50	45

Note.—This course and examination is also undergone by chief and signal boatswains once during their service.

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EXAMINATION FOR SIGNAL RATINGS.

A = Number of marks allowed.
B = Rate of sending per minute.
C = Number of marks required to pass.
D = Number of words to be read correctly in five minutes.

Rating being Examined for.	Semaphore. Reading 50 words prose.			Flag Waving. Reading 25 words prose.			Flashing.			Sounder.	Buzzer.	Examination Papers.						W.T. procedure. 50 marks.
												Part 1. 200 marks.	Part 2. 200 marks.	Part 3. 200 marks.	Extra paper. 100 marks.	Telegraphy paper. 100 marks.	W.T. paper. 200 marks.	
	A	B	C	A	B	C	A	B	C	D	D	C	C	C	C	C	C	C
Ordinary Signalman.	100	20	92	100	12	88	100	10	92·1	60	60	160	160	160	—	—	A—50—40	—
Signalman – –	100	20	94	100	12	92	100	10	94·7	70	70	170	170	170	—	—	A—50—42	—
Leading Signalman.	100	20	96	100	12	96	100	10	94·7	90	90	170	170	170	—	90	180	45
Yeoman – –	100	20	98	100	12	96	100	10	97·3	100	100	170	170	170	85	90	180	45
Chief Yeoman –	100	20	98	100	12	96	100	10	97·3	105	105	180	180	180	90	90	180	45

NOTES.—(1) For subjects in which Signal ratings are examined, but for which no marks are allotted *see* detailed syllabus of examination for each rating.

(2) The results shown above to be obtained by Leading Signalman are those for Leading Signalmen after a requalifying course. For results to be obtained by Signalmen passing for Leading Signalmen *see* notes to syllabus of examination for Leading Signalmen.

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Principal Steamship Lines.

The following are to be considered as the principal mercantile lines, for the purpose of questions in extra papers :—

Aberdeen Line.
Allan Line.
American Steamship Company.
Anchor Line,. Glasgow.
Anchor Line, Hull.
Atlas Line.
Austro-Hungarian Lloyd, S.N. Company.
Beaver Line.
Bibby Bros. & Co.
Booth Steamship Company.
British and African S.N. Company.
British India S.N. Company.
Canadian Pacific Railway.
China Merchants S.N. Company.
China Navigation Company.
China Shippers Mutual S.N. Company.
City Line.
Clan Line.
Compagnie Générale Transatlantique.
Cunard Line.
Donald Currie & Co.
Dominion Line.
Eastern Telegraph Company.
Elder, Dempster & Co.
Federal Line.
Furness Line.
Hall, John, Junior, & Co.
Hamburg-American Line.
Holt, Alfred.
Indo-China S.N. Company.
Inman Line.
Jardine Matherson.
Leyland Line.
Messageries Maritimes.
Moss Line.
New York, Havana and Mexican S.S. Company.
New Zealand Shipping Company.
Nippon Yusan Kaisha.
Norddeutscher Lloyd.
Occidental and Oriental Line.
Orient Steam Navigation Company.
Oriental Steamship Company.
White Star Line.

For Ordinary Telegraphist.

Boy Telegraphists will be rated Ordinary Telegraphists at the age of 18, or, if particularly promising, at 17½.

For Telegraphist.

After nine months' service as Ordinary Telegraphist, six of which must have been spent at sea, and must pass the following examination, which may be taken after three months' service as Ordinary Telegraphist :—

(1) Speed of signalling of 20 words a minute.
(2) Good knowledge of the instruments in the ship and of the Wireless signalling instructions.
(3) Fair knowledge of Cruiser dispositions.
(4) Fair knowledge of the method of charting relative positions of Cruisers rapidly.

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For Leading Telegraphist.

After 18 months' service as Telegraphist, and if recommended by Commanding Officer, a Telegraphist may pass the following examination :—

(1) Speed of signalling of 20 words a minute.
(2) Thorough knowledge of the instruments in the ship and of the Wireless signalling instructions.
(3) Good knowledge of Cruiser dispositions.

After passing this examination, and after two years' service as Telegraphist, including one year's sea service, Telegraphists will be rated as vacancies occur.

Leading Telegraphists for Higher Rate of Pay.

After one year's service as Leading Telegraphist a man may pass the following examination in order to qualify for pay at the rate of 2*s.* 10*d.* a day :—

(1) Speed of signalling of 25 words a minute.
(2) A thorough knowledge of the Wireless signalling instructions and organisation. A thorough knowledge of the instruments in the ship, and to be able to draw the various circuits. To be able to use a wavemeter.

(The courses marked are now under revision.)

For Petty Officer Telegraphist.

After two years' service as Leading Telegraphist a man may, if recommended from sea for advancement, go through a course of 55 days in H.M.S. "Vernon" as follows :—

	Days.
School	15
Direct Current Electricity	5
Wireless Telegraphy	30
Visual Signalling at Signal School (This course is under revision.)	5
Total	55 days.

They will then be rated as vacancies occur, provided they have three years' service as Leading Telegraphist.

For Chief Petty Officer Telegraphist.

Four years' service at sea as Petty Officer Telegraphist. Promotion will be by seniority and recommendation tempered by selection.

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For Warrant Officer.

Candidates must be Chief or Petty Officers, Chief or Yeoman of Signals, or Chief Petty Officer or Petty Officer Telegraphists, with not less than one year's service in either of those ranks. They must have seven years' service. They must pass an educational examination, and also a qualifying examination in their particular branch of the Service, *i.e.*, Gunner, Torpedo Gunner, Boatswain, Signal Boatswain, or Warrant Telegraphist.

For Mate.

Selected Petty and Warrant Officers will be promoted to Mate from time to time in accordance with Admiralty Instructions.

For Lieutenant.

By promotion from the rank of Mate,
For War Service, or
By selection from Chief Warrant Officers after long service.

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INDEX.

A.

Acetylene Flashing Lantern, 50.
Admiral, Lord High, Flag, 31.
Admiral's Flags, 31.
Admiral's Staff, Wearing of Aiguillettes, 7.
Admiralty Flags, 31.
Admiralty Pattern Anchor, 275.
Advancement of Seamen, &c., Courses for, 403.
Aide-de-Camp to the King, Aiguillettes, 7.
Alexandra, Queen, Standard, 31.
Alphabet, Morse, 42.
  Notes on learning, 44.
Anchor, Buoy, 300.
Anchoring, 300 (*see* Weighing, and Mooring).
Anchors, and Anchor-Work, 272, 275.
  Admiralty Pattern, 275.
  Cables, 281.
  Close-Stowing, stowed vertically, 280.
  Definitions, 272.
  Inglefield's, 279.
  Kedge, 278.
  Martin's Close-Stowing, 275.
  Stockless, 276, 281.
  Supplied and Uses for, 277.
  To lay out a Bower or Sheet Anchor, 319.
  To lay out and weigh a Kedge Anchor, 320.
  To lay out and weigh a Stream Anchor, 318.
  To lay out the Anchor in Shallow Water, 316.
  To weigh a Bower or Sheet Anchor laid out in a boat, 317.
  To weigh the Anchor, 321.
  Wasteney Smith's, 281, and illustration facing p. 277.
  Weighing, 302.
  Weights and Working Strains, 320.
Anemometers, 379.
Arc Lamp, Everett's Cruiser, 49.
Ash Party, 25.
Attaché, Naval, Wearing of Aiguillettes, 7.
Awning Curtains, 358.
Awnings, 357.
  Method of Spreading, 357.
  Side Screens, 358.

B.

Badges, Distinguishing, Men and Boys, 13.
  Good Shooting, 22.
  Shoulder, relative ranks, 11, 12.

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Bag, How to Stow Kit in, 3.
To put a Bottom in a, 120.
Bark or Barque, 323.
Barometer, Aneroid, 376.
Mercurial, 374.
Barquentine, 323.
Bathers, Hints to, 373.
Battledore, 288.
Beaufort's Notation, Force of Wind, 379.
Bedding, How to Mark, 2.
Bends and Hitches, Slings, &c., 59–76.
Bale Sling, 74.
Blackwall Hitch, 62.
Bowline, 67.
Bowline on the Bight, 68.
Butt Sling, 74.
Can Hooks, 76.
Carrick Bend, 65.
Catspaw, 71.
Clove Hitch, 60.
Double Blackwall Hitch, 63.
Figure of Eight Knot, 69.
Fisherman's Bend, 64.
Half Hitch, 59.
Marline Hitch, 63.
Marline Spike Hitch, 62.
Midshipman's Hitch, 64.
Overhand Knot, 68.
Parbuckle, 73.
Reef Knot, 65.
Rolling Hitch, 70.
Rope Yarn Knot, 71.
Round Turn and Two Half Hitches, 62.
Running Bowline, 68.
Sheepshank, 70.
Sheet Bend, 66.
Timber Hitch, 59.
To pass a Life Line, 76.
To Pass a Stopper, 72.
To put a Strop on a Hemp Rope, 72.
To put a Strop on a Spar, 73.
To put on a Tail Jigger, 74.
To secure a Rope round a Cleat, 76.
To Sling a Cask Head up, 75.
To Sling Casks, 74.
Bicycle, How to Salute when Riding, 4.
Binnacle, 171, 174.
Bitt Pin, 288.
Bitts, 288.
Blackwall Hitch, 62.
Double ditto, 63.
Blake Stoppers, &c., 283.
Blocks, 121.
Differential, 128.

Digitized by Google

Blocks—*cont.*
Gin Blocks, 122.
Internal Iron-Bound Blocks, 121.
Parts of a Block, 121.
Snatch Blocks, 122.
Stropping Blocks, 122.
Swivel Blocks, 122.
Weston's Patent, 128.
Boat-Hoisting Machinery, 340.
Derricks, 337.
Electric Hoists, 341.
Hoisting in a Steamboat, 343.
Hydraulic Hoists, 341.
Steam Hoists, 341.
Boat Pulling, 207.
Hints to Instructors, 213.
Notes on Style and Faults, 210.
Training Boats' Crews, 214.
Boat Sailing, 236.
Definitions, 237.
Dingy and Skiff-Dingy, 247.
Dipping Lug Cutters, 242.
Dipping Lug Foresail and Mizzen, 246.
Gigs and Whalers, 247.
Handicaps and Classes for Service Rigs, 267.
Hints on, 248.
Launches and Pinnaces, 239.
Method of Bending and Bringing-to Boats' Sails, 238.
Parts of a Sail, 236.
Boat Work, 201.
Parts of a Boat, 203.
Boats,
Boarding a Wreck, 234.
Boat-Hoisting Machinery, 340.
Carvel Built, 201.
Clinker Built, 201.
Compasses, 181.
Derricks for Boat-Hoisting, 337.
Diagonal Built, 201.
Disengaging Gear for, 215.
Petts', 222.
Robinson's, 216.
Distinctive Flags in, 53.
Flashing Lantern, 49.
Gear contained in Service Pulling, 206.
General Racing Rules, 263.
Landing in a Surf, 229, 234.
Lowering and Hoisting, 215.
Management of Pulling, 226.
Montagu, 201.
Reply when Hailed at Night, 56.
Rowing to Seaward, 230.
Running before a Broken Sea, 231.
Salutes in, 53, 55.

Digitized by Google

Boats—*cont.*
Sea, 223.
Signals, 51 (*see* Signals, Boats').
Steam, 250.
Fitting for Towing Heavy Lighters, 255.
Gear contained in, 250.
Hoisting in a Steamboat, 343.
Management of, 250.
Notes, 253.
Raising Sunken Picket Boat, 256.
To Turn in a limited Space, 253.
Use of Helm, 253.
Stowage of, 205.
Table of Weights, &c., 261, 262.
To haul up on a Beach, 228.
To Lower Davits, 206.
Towing, 227.
Watering Ship with, 236.
Boltrope, 101.
Bowline, 67.
On the Bight, 68.
Running, 68.
Brig and Brigantine, 323.
Bullivant's Fixed and Portable Nipper, 291.
Buoy, Anchor, 300.
Securing to a, 301.
Securing Head and Stern between two Buoys, 310.
Burton, 126.
Spanish, 124.

C.

Cable, Bitting, 288.
Clench, 285.
Holders, 292, 297.
Lead of, 299.
Power of Holders, 298.
Ranging, 299.
To Bring-to, 298.
To Survey, 321.
Cables, 281.
A Ganger, 286.
Anchor Shackle, 283.
Battledore, 288.
Bitt Pin, 288.
Bitts, 288.
Cable's Length, 282.
Compressor, 289.
Controller or Bow Stopper, 289.
Joining Shackle, 282.
Can Hooks, 76.
Canvas, 120.
Various Classes used, 120.

Digitized by Google

Capstans, 292.
Electrical, 295.
Power of, 298.
To Pass a Swifter, 296.
To Weigh with Central Capstan, 303.
Carpenter's Stopper, 290.
Carpenter of Watch, 25.
Carrick bend, 65.
Cases, Identification Marks on, 385.
Casks, Identification Marks on, 385.
How to Sling, 74, 75.
Catching-up Rope, 311.
Catspaw, 71.
Chain Hook, 273.
Cherub Log, 153.
Clarke Chapman's Cable Holder, 297.
Cleat, To Secure a Rope round a, 76.
Clothes, Lines, to Stop Hammocks on, 2.
Stop, How to put in a, 3.
Washing, 3.
Clothing, How Marked, 3.
How Packed, 383.
Stowage of in a Kit Bag, 2.
To Mark, 3.
Clove Hitch, 60.
Coaling, 356.
Coaling Spans, 333.
Code, The Morse, 40.
Coir Rope, 101, 104.
Collision Mat, 348.
Collisions, Regulations for Preventing, 271.
Commodore, Broad Pendant, 32.
Compass :
Anschutz, 175.
The Mariner's, 170.
Binnacles, 171, 174.
Boat's Compasses, 181;
Card, 182–184.
Gyro, 174.
Hints on Learning and Teaching, 185.
Kelvin's Compasses, 172.
Liquid Compasses, 172.
Remarks on Steering, 190.
Sperry, 177.
Standard Compass, 180.
Compressor, 289.
Cone and Flag Men, 24.
Connaught, Duke of, and Prince Arthur of, Standards, 31.
Controller or Bow Stopper, 289.
Cordage, Hawserlaid, Manufacture of, 103.
Courses, Syllabus of, Seamen Ratings, 403.
Cringle, To finish off a, on the Crown, 119.
To make a, 118.
Crown Knot, 79.

Digitized by Google

Cruiser Arc Lamp, Everett's, 49.
Cutter, 323.

D.

Darning, 120.
Defaulters, Hat or Cap to be removed, 5.
Derricks, 347.
Boat-Hoisting, 337.
Boat-Hoisting Machinery, 340.
Derrick Blocks, 339.
Fore Derrick, 339.
Rigging of, 338.
Sheers and, 344.
Tests for, 340.
To Work Main Derrick by Hand, 344.
Diamond Knot, 83, 85.
Disengaging Gear, 215.
Petts', 222.
Robinson's, 216.
Distance Recorder, 161.
Distinction Lace worn by Naval and Military Officers, 8–10.
Distinguishing Badges, all Ratings, 13.
Worn on Left Arm, 13.
Worn on Right Arm, 14.
Doors, Watertight, 359.
Dressing Lines, 333.
Drowned, Treatment of apparently, 367.
Drums, Oil, Distinguishing Colours, 385.

E.

Electric Boat Hoists, 341.
England, National Flag of, 26.
Ensigns, Hoisting and Hauling down, 33.
Measurements of, 33.
Red, White and Blue, 28.
Everett's Cruiser Arc Lamp, 49.
Eyelet-hole, To make an, 118.

F.

Fender, To make a Pudding, 116.
Fire, To lash up a Hammock in case of, 1.
Fisherman's Bend, 64.
Flag and Cone Men, 24.
Flag, National, of England, 26.
Union, 26.
Waving, Signalling by, 37.
Flags, Admiralty and Admirals', 31.
Distinctive in Boats, 53.
Measurements of, 33.
Of all Nations, Book, 33.
Signal, Naval Code of, 34.
Sizes of, 34.
Flashing Signals, 40.
Flashing Lamps, 47.

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Flashing Lanterns, Acetylene, 50.
Boats', 49.
Everett's Cruiser Arc Lamp, 49.
Multiple Fibre Masthead, 47.
Oil, with Scott's Shutter, 48.
Fog, Sound Signals in a, 269.
Forbes' Distance Recorder, 161.
Ship's Log and Speed Indicators, 155.
Step by Step Movement, 169.
Fox and Spanish Fox, How to Make, 102.
Funeral, Body to be Saluted, 5.

G.

Ganger, 286.
Gantlines, 333.
To Stop Hammocks on, 2.
Grating, How to Sling a, 75.
Grommet, 92.
Strop, 110.
Gunnery and Torpedo Courses, 409.
Gyro Compass, 174.

H.

Hail, Reply at Night, 56.
Halliards, Signal, 102.
Hammocks, How to Sling, 1.
Lashings and Lanyards, 101.
To Hang up and Secure Lanyards, 1.
To Hold up for Inspection, 2.
To Lash up, in all cases (Fire, &c.), 1.
To Scrub, 2.
To Stop on Gantlines, or Clothes Lines, 2.
Handy Billy, 125.
Harfield's Cable Holder, 297.
Capstan, 294.
Hawse Pipes, 286.
Hawse, Slip, Clear, 284.
To Clear, 309.
Hawsers, How to bend together, 72.
Laying out Wire and Hemp, 322.
Preservation of Wire, 322.
Steel Wire, Splicing, 96.
Wire, 107.
Testing, 107.
Helmsman, 24.
Hemp Hawsers, 104.
Breaking Strain, 104, 105.
Hemp Rope, Marking of, 103.
Hitches (*see* Bends and Hitches).
Hoists, Steam, Electric and Hydraulic, 341.
Hook Rope, 273.
Hook, To mouse a, 72.
Hooks, Can, 76.
Hydraulic Boat Hoists, 341.

Digitized by Google

I.

Identification Marks on Casks and Cases, 385.
Implements and Mess Utensils, 383.
Inspection, How to Hold up a Hammock for, 2
Instruments, Meteorological, 374.
International Code, 57.
Salutes, 57.
Ireland, Union with, 27.

J.

Jigger, 125.
Jigger, To put on a Tail, 74.
Joggle Shackle, 286.
Joining Shackle, 282.
Junk, 101.

K.

Kedge Anchors, 278.
To Lay out and Weigh, 320.
Kelvin's Compasses, 172.
Sounding Machine, Mark IV., 133.
Ketch, 323.
Kisbie Life Buoy, 364.
Kit, How to Stow in a Bag, 3.
Knots and Splices, 77–98.
Crown Knot, 79.
Double Diamond Knot, 85.
Double Matthew Walker Knot, 83.
Double Wall Knot, 79.
Figure of Eight Knot, 69.
Manrope Knot, 80.
Overhand Knot, 69.
Reef Knot, 65.
Rope Yarn Knot, 71.
Shroud Knot, 85.
Single Diamond Knot, 83.
Single Matthew Walker Knot, 81.
Splicing, 86.
Turk's Head and Stopper Knot, 80.
Wall Knot, 77.

L.

Lace, Distinction, worn by Naval and Military Officers, 8–10
Lamp, Everett's Cruiser Arc, 49.
Lamps, Flashing, 47.
Lanyards, How to Secure Hammock, 1.
Hammock, 101.

Digitized by Google

Lashing, Hammock, 101.
Stage, 101.
Lead and Line, Boat, 132.
Deep Sea, 132.
Hand, 130.
Lead Line, Deep Sea, 101.
Hand, 101.
Leadsmen, 24.
Life-Belt, 225.
Life Buoy, Kisbie, 364.
Night, 364.
Life Line, To pass a, 76.
Life Saving, 365.
Lightning Conductors, 331.
Log and Speed Indicators, Forbes' Ships', 155.
Log-Line, Patent, 102.
Logs, 147.
Cherub Log, 153.
Hand Logs (obsolete), 147.
Length of Line, 149.
Neptune, 147.
Neptune Electric, 149.
Trident Electric Log, 152.
L.T.O. of Watch, 25.
Luff, 124.
Luper, 103.

M.

Man Overboard, 363.
Manrope Knot, 80.
Manual, British Signal, 57.
Marking Clothing, 3.
Marline Hitch, 63.
Marline Spike Hitch, 62.
Masthead Man (*see* Look-outs).
Masts, 324.
Rigging of Lower Mast, 327.
Topmast, 329.
Matmaking, 121.
Paunch Mat, 112.
Thrum Mat, 115, 349.
To Splice a Sword Mat, 114.
Sword Matting, 113.
Mats, Collision, 348.
Matthew Walker Knot, 81, 83.
Measurements, 381.
Of Flags, &c., 33.
Measures, Weights and, 386.
Mess Utensils, 383.
Messengers, 24.
Meteorological Instruments, 374.
Midshipman's Hitch, 64.

Digitized by Google

Mooring, 305.
Head and Stern, 308.
Securing Head and Stern between two Buoys, 310.
Securing to a Buoy, 309.
Swivel, 286.
To Clear Hawse, 309.
To Moor Ship, 306.
Unmooring, 307.
Morse, Alphabet, 42.
Notes on learning, 44.
Code, 40.
Flags, 39.
Numerals, 42.
Special Signs, 43.
Symbols, 41.
Mousing a Hook, 72.

N.

National Flag of England, 26.
National Flags, Descriptions, 33.
Navel Pipes, 286.
Neptune Log, 147.
Electric Log, 149.
Net Defence, Torpedo, 350.
Nets and their Stowage, 354.
Rigging of Booms, 352.
Nettle Stuff, 101.
Night Quarters, Lashing up Hammocks for, 1.
Nippers, Bullivant's Fixed, 291.
Bullivant's Portable, 291.

O.

Oakum, 101.
Officers, Marks of Rank, 6.
Oil Drums, Distinguishing Colours, 385.
Overboard, Man, 363.
Overhand Knot, 69.

P.

Parbuckle, 73.
Parcelling Rope, 93.
Parrel, 334.
Paunch Mat, 112.
Pett's Disengaging Gear, 222.
Physical Training Instructors, Qualifications for, 409.
Picket Boat, Raising Sunken, 256.
Provisioning, Preparing for, 384.
Stowage of Holds, 384.
Provisions, 382, 383.

Digitized by Google

Purchase, Four-fold, 128.
Three-fold, 127.
Purchases, 123.
Burton, 126.
Differential Blocks, 128.
Double Whip, 123.
Effect of Friction, 128.
Four-fold Purchase, 128.
Handy Billy, 125.
Jigger, 125.
Luff, 124.
Power gained, 128.
Runner, 124.
Runner and Tackle, 127.
Single Whip, 123.
Spanish Burton, 124.
Three-fold Purchase, 127.
Up-and-down Tackle, 126.

Q.

Queen Alexandra, Standard for, 31.
Queen, H.M., Standard for, 31.

R.

Rank, Marks of, in Officers, 6.
Rattling Down, 336.
Recall, General, for Boats, 51.
Reef Knot, 65.
Reply when Hailed at Night, 56.
Respect, Marks of, 4.
Resuscitation Drill, 370.
Reverselaid Rope, 104.
Rigging, 323.
Derricks, 337.
Girdlines or Halliards, 330.
Lightning Conductor, 331.
Masts, 324.
Of Lower Mast, 329.
Ratlines, 329.
Rattling Down, 336.
Running Rigging, 333.
Clothes Lines, 333.
Coaling Spans, 333.
Dressing Lines, 333.
Hammock Gantlines, 333.
Pole Gantlines, 333.
Signal Halliards, 334.
Signal Jackstay, 333.
Signal Yards, 334.
Topmast Gantlines or Halliards, 333.

Digitized by Google

Rigging—*cont.*
Shrouds, 327, 328.
Steel Wire Rope for Standard Rigging, 336.
To send the Yards down, 336.
To Strike the Topmast, 335.
Topgallant Mast, 331.
Topmast Rigging, 330.
Yard for Wireless Telegraphy, 332.
Robinson's Disengaging Gear, 216.
Rolling Hitch, 60.
Rope (*see* Splicing).
Boltrope, 101.
Coir, 101.
Four Stranded, 101.
How to Graft, 90.
How to Point, 89.
How to Whip, 91.
Steel Wire, 93.
To Worm, Parcel and Serve a Rope, 93.
Ropemaking, 109.
Hawser Laid Rope, 100.
Rope Yarn Knot, 71.
Rounding, 101.
Royal Standards, 31.
Rule of the Road at Sea, 268.
Sound Signals in a Fog, 269.
Special Lights, 269.
Steering and Sailing Rules, 270.
Runner, 124.

S.

Sailmaking, 117.
Canvas, 120.
Darning, 120.
Middle Seam, 118.
Round Seam, 117.
Tabling, 120.
To finish a Cringle off on the Crown, 119.
To Make a Cringle, 118.
To put a Bottom in a Bag, 120.
To make an Eyelet-hole, 118.
Salutes, Naval, 4.
How and when to make, 4.
In Boats, 53–55.
Schäfer Resuscitation Drill, 370.
Schooner and Topsail Schooner, 323.
Scotland, Union with, 26.
Screens, Side, 358.
Scuttles, Flush, 362,
Watertight, 362.
Sea Boats, 223.
Sea Boat's Crew, 25.
Seaboat Lowerers, 25.

Digitized by Google

Seaman Gunner of Watch, 24.
Sea Terms, 387–402.
Seam, Middle, 118.
Round, 117.
Searchlight Signalling, 50.
Seizings, 98.
Flat Seizing, 99.
Racking Seizing, 99.
Round Seizing, 98.
Selvagee Strop, How to Make a, 90.
Semaphore, Flag, and How to Answer, 35.
Instruction, 35.
Notes on Instruction, 36.
Special Signs, 35.
Senhouse Slip 284.
Connection of, to Towing Pendant, 287.
Sennit, 101, 115.
Common, 115.
Square, 116.
Sentry of Lifebuoy, 24.
Serving a Rope, 93.
Shackle, Anchor, 283.
Joggle, 286.
Joining, 282.
Reaming a, 283.
Sheepshank, 70.
Sheers and Derricks, 344.
Derricks, 347.
Sheers, 345.
Sheet Bend, 66.
Shoulder Badges, Relative Ranks, 11, 12.
Shroud Knot, 85.
Signal, Flags, Naval Code of, 34.
Sizes of, 34.
Signal, Halliards, 102, 334.
Manual, British, 57.
Yards, 334.
A Parrel, 334.
Signalling by Flag-waving, 37.
By Searchlight, 50.
Signals, Chapter II.
Boats', 51.
Flashing, 40.
Morse Code, 40.
Signals, Boats', 51.
Distinguishing Signals, 51.
Recall, General, 51.
To look out and make a Signal, 51.
Slings, Butt and Bale, 74.
Slip, Clear Hawse, 284.
Senhouse, 284.
Snatch Block, 122.

Digitized by Google

Sounding Machines, 133.
Kelvin's, Mark IV., 133.
Motor, 140.
Sounding, Methods of, 130, 136.
Boat Lead and Line, 132.
Calling Soundings, 131.
Deep Sea Lead and Line, 132,
Hand Lead and Line, 130.
To Haul in the Line, 131.
To Heave the Lead, 131.
Sounding Party, 25.
Soundings, Calling, 131.
To take, from Forward, 136.
Spanish Burton, 124.
Spanish Fox, 102.
Speed Indicators, Elphinstone's, 161.
Splicing, 86.
Hemp Splicing, 86–93.
Chain Splice, 89.
Cut Splice, 88.
Eye Splice. 87,
Hemp Short Splice, 86.
Long Splice, 87.
To Graft a Rope, 90.
To Make a Grommet, 92.
To Make a Selvagee Strop, 90.
To Splice a Sword Mat, 114.
To Splice Three and Four Stranded Rope together, 92.
To Whip a Rope, 91.
To Worm, Parcel and Serve a Rope, 93.
Whipping, 92.
Wire Splicing, 94–98.
Eye Splice, 96.
Short Splice, 95.
Splicing Wire Rope into an Endless Band, 96.
Steel Wire Hawsers, 96.
Spun Yarn, 101.
Standard Compass, 180.
Standards, Measurements of, 33.
Royal, 31.
Steel Wire Rope, 93 (*see* Wire Rope).
Test for Flexible, 111.
Steering, Remarks on, 190.
Stopper, Blake Screw, 283.
Blake Slip, 283.
Blake Stopper Bolt, 283.
Bow, or Controller, 289.
Carpenter's, 290.
Knot, 80.
To Pass a, 72.
Wire Rope, 290.

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Strop, Selvagee, How to make a, 90.
Strop, To put a, on a Hemp Rope, 72.
On a Spar, 73.
Strops, Grommet, 110.
Wire, 110.
Surf, Landing in a, 229, 234.
Surge, To, 272.
Swifter, To Pass a, 296.
Swivel and Swivel-piece, 283.
Mooring, Swivel, 286.
Sword Matting, 113.
To Splice a Sword Mat, 114.
Syllabus of Courses, Seamen Ratings, 403.

T.

Tabling, 120.
Tackle, Runner and, 127.
Up and Down, 126.
Testing Wire Rope, 107.
Terms, Sea, 387–402.
Thermometer, 377.
Maximum, 377.
Minimum, 378.
Thrum Mat, 115.
Tiller, 190.
Timber Hitch, 59.
Time, on Board Ship, 22.
Torpedo Net Defence, 350.
Nets and their Stowage, 354.
Rigging of Booms, 352.
Towing Boats, 227.
Tricks, 23.
Flag and Conemen, 24.
Helmsman, 24.
Masthead Man, 23.
Night-time, Helmsman, 23.
Flag and Cone Men, 24.
Leadsman, 24.
Look-outs, 23.
Messengers, 24.
Sea Boats' Crews, 25.
Trident Electric Log, 152.
Turk's Head and Stopper Knot, 80.
Twine, 101.

U.

Union, Flag, 26.
With Ireland, 27.
With Scotland, 26.
Unmooring, 307.

V.

Valves and Watertight Doors, 359.
Vernier on a Barometer, 376.

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W.

Wales, Prince of, Standard for, 31.
Wall Knot, 77.
    Double ditto, 79.
Warp, in Cloth, 33.
Warping, 272.
Watches, Division of Day into, 22.
    Seamen, 23.
Watertight Doors and Valves, 359.
Watertight Scuttles, 362.
Weft, in Cloth, 33.
Weighing, by Hand, 304.
    With Central Capstan, 303.
    With Deck Tackles, 304.
Weights and Measures, 386.
Whip, Double and Single, 123.
Whipping, American, 92.
    To Whip a Rope, 91.
    West Country, 92.
Winds, 378.
    Force of, 381.
        Beaufort's Notation, 379.
Wire Hawsers, Preservation of, 322.
Wireless Telegraphy, Yard for, 332.
Wire Rope, 105.
    Steel, 93.
        Flexible, 106.
            Strops, Test of, 111.
            Tests for, 107.
        For Standing Rigging, 336.
        Rule for ascertaining strength of, 110.
        Sections of, 106.
        Table of Breaking Strains, &c., 109.
Wire Strops, 110.
Worming a Rope, 93.
Wreck, Boarding a, 234.
    Lights for (Plate), following p. 271.

Y.

Yachts, Certain, allowed Special Ensigns, 29.
Yards, Signal, 334.
Yarn, Rogue's, Marking of Hemp Rope, 103, 398.
Yawl, 323.
Yoke, 190.

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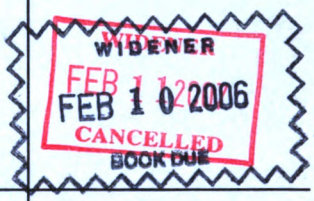

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